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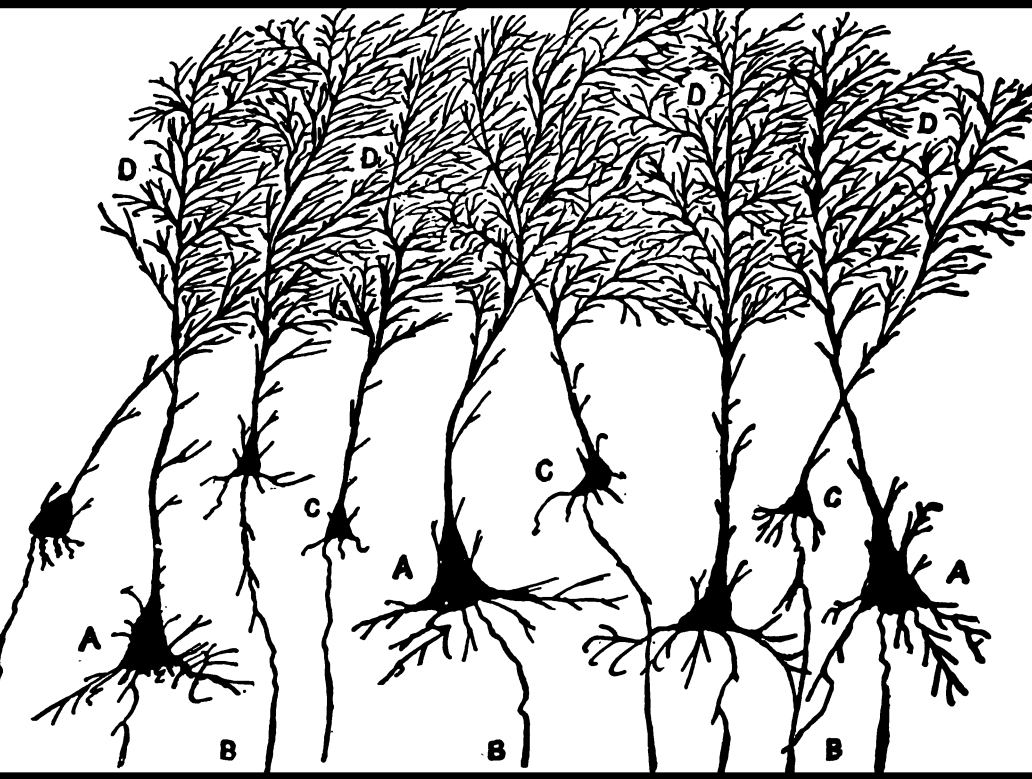

Natural salvation

Charles Asbury Stephens

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Natural Salvation

THE FIRST PRINCIPLES OF IMMORTAL LIFE ON THE EARTH, FROM THE EVOLUTION OF THE HUMAN BRAIN AND THE GROWTH OF HUMAN KNOWLEDGE

BY

C. A. STEPHENS, M. D.

THE LABORATORY
NORWAY LAKE, MAINE
1907

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DEDICATION.

Natural Salvation is addressed to all earnest students of Life and dedicated to that greater new era of Humanity which Science ushers in.

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PREFATORY NOTE.

The researches made at this laboratory and its publications embrace,

LIVING MATTER; *Its Cycle of Growth and Decline in Animal Organisms.* 1888.

PLURICELLULAR MAN; *Whence and What is the Soul?* 1892.

LONG LIFE; *An Investigation of the Intimate Causes of Old-Aging and Organic Death, with a View to their Alleviation and Removal.* 1896.

NATURAL SALVATION; *The Message of Science; Outlining the First Principles of Immortal Life on the Earth.* 1903.

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INTRODUCTION.

NATURAL SALVATION OUTLINED.

IT has been said often, and said as a reproach, that modern science, meaning the systematized growth of human knowledge for three centuries, has invalidated religious faith and left us nothing in its place; that this self-same science controverts the creeds, particularly the Christian creed, and offers no substitute for it; that its incessant advances sap popular belief in God and salvation by supernatural grace and yield no consolation at death. In brief, that it has been and is of the nature of a destructive agency, an iconoclastic force, which destroys the long-established cults of mankind, leaving us nothing with which to replace them.

Hence the present attitude of conservative thought — the serious-minded thousands who have the common good at heart, who look to the past as well as to the future, and who instinctively feel the world's needs. All this great conservative class of minds, the class which holds humanity together in its larger evolution and steadies it in its onward progress in time, has long viewed this aspect of science, the creed-subverting aspect, with distrust and apprehension. It has feared that not alone religious

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doctrines will be discredited, but that common morality will slacken and an era of personal selfishness supervene in place of the higher spiritual mentality of our forefathers who so implicitly believed in a life after death, in Heaven, or in Hell.

In justification of this attitude, conservatives have pointed to the sordid self-seeking of the last half century, its money-greed, church hypocrisy, and practical "atheism."

Pondering it more deeply, too, this proper, conservative sentiment contemplates with especial dread the abrogation of faith in immortal life for the individual man: that fondest hope of the human heart, that instinctive aspiration of the soul, which in some form the higher life of man demands, and without which human beings do not work at their best, nor renounce self. The clearest minds among us realize that the hope of personal immortality can not, must not, be given up, *in toto;* that to deny this hope is a virtual negation of life itself, a *non-sequitur* of human evolution.

Yet year by year, science has gone on, sphynxlike, invalidating and annulling the beliefs of our fathers, until to-day little enough of them remain; — each of the many, well-meant efforts to "harmonize" religion and science but disclosing more clearly the impassable gulf between them, and the well-nigh ludicrous flimsiness of the "evidence" on which faith in disembodied soul life rests. Until, with this whole great class of conservative

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thinkers and well-wishers of their race, there has come a kind of consternation as to what will, or can possibly, result from so revolutionary a growth of human knowledge. In what future faith can it eventuate?

And hitherto no answer to the question has been forthcoming. The effacement of creeds goes on with no hint as to replacement. Science, like the Hun of antiquity, has left nothing behind save ashes and desolation. And from some quarters grave fears have found expression lest with the fading out of the belief in immortal life, our civilization should wither from its higher sources, and the *genus homo* revert to the lower animal order from which it is sprung.

Hence the reproach. Hence the distrust of science.

And in a sense the reproach has been merited. Science has grown slowly, impersonally, without responsibility, without plan and without regard to results. It is the mind and brain of the race which has been developing, and garnering data for future use. The invalidation of old creeds has been incidental merely to this growth in knowledge, without design or animus. These centuries of incubation have been required, ere we could pass from the creeds of Asia to new conditions of intellect, and formulate a better creed, one nearer truth.

But the time for it has come. The reproach can no longer be uttered. Science, the organized scientific knowledge of our era, has now its nobler creed to offer

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those who are willing to go forward and embrace a new and better gospel of life.

It is the purpose here to set forth this New Gospel of Life, this flower and fruit of scientific knowledge; and in the papers of *Natural Salvation*, which follow this introduction, an attempt is made to demonstrate it.

In the first paper, *Natural Salvation, the Message of Science*, it is pointed out that ever since the cell-of-life appeared on the earth, there has been an instinctive effort in progress to save and perpetuate this small, individual life; that the metazoons (animals, trees) are so many intuitive, long-developed attempts on the part of the unicells to immortalize themselves; and that the greater, communal life of man is a continuation of this same effort to attain a grander, happier, deathless life. In a word, that natural salvation has been the key-note of life from the first; and that in science, meaning the organized growth of human knowledge, we have now the promise of immortal life for man.

The second paper, *At the Darkest Hour, the Hour Before the Dawn*, is retrospective of the human situation on the earth, and of the often erratic religious form the desire for immortal life has taken in the past.

In the third paper, *Brain, A Still Progressive Tissue*, is shown that in the brain of man, the cell-of-life has attained its highest, most enduring development; that the human brain, preeminently, is a still progressive tissue of

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the organism; that the progressive growth of brain stands for the growth of science and is a corelative of it; and that science is raising human beings upward from brute-hood to Godhood.

In the fourth paper, *The Human Personality, Its Composite and Dissoluble Nature*, is demonstrated the means and histological method in which the component cells of the brain unite and pool their separate, individual lives in one larger life, to live consentiently together as a human intellect; and also what occurs when at death this bond of consentient personality is disrupted and the component individual lives of cell, of molecule, of atom, of corpuscle, dissolve partnership and separate, to enter other forms of matter. It is the partnership, the personality alone, which dies, not the eternal life of matter itself.

In the fifth paper, *The Intimate Causes of Old Age and Organic Death*, a résumé of the theories and causes of the old-aging of animal organisms, is given and the problem of organic renovation outlined.

In the sixth paper, *Self-Conservation and Self-Maintenance*, a first attempt is made to sketch a system of culture and husbandry of the cells of the brain and nervous system. In a word, the conservation and control of the output of brain-cell energy; and the application of that stock of energy to self-maintenance and self-preservation, with a view to a normal, natural prolongation of healthy human life. Certain original researches have been carried on and

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a field of great promise entered, looking to the employment of the united brain-cell energy of many healthy persons, in conjunction, not only for self-restoration, but for curing the sick. Vast remedial powers lie latent here.

Other laboratory papers, in preparation for future editions of *Natural Salvation*, treat of —

How Deathless Life will be Achieved.

Jesus and His Scheme of Immortal Life; What it really was originally.

What Shall We Teach our Children?

New Creations of Vital Capacity in the Human Organism.

The Transfiguration of the Human Face and Form.

Eternal Life; Under What Conditions it Could be Accepted and Endured.

For clearness' sake, it may be well to summarize, in brief, the facts and truths on which the greater, new faith of science rests. Succinctly, it is the net result of three centuries of what the world terms modern science, the organized, systematized growth of human knowledge, since medieval times.

I. Of Matter and of Life. — The new, later knowledge of universal matter presents it, not as a dead,

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inert mass, operated in space, by supernatural power, but as a subjective, sentient unity, existing during all time and having within it the potency of nature as we see it, including life and human personality; a living entity, possessing a lowly sentient property from which every mode of motion and every form of life proceed. Not a dead universe, but an ever-living one.

The lowest, the most archaic estate, or attenuation of matter, concerning which we now have knowledge, is the ether, so called, in lack of a better term; the omnipresent ether, intimately associated with gravitation. Of the composition or organization of the ether we have no knowledge as yet.

The next lowest attenuation of matter of which we have knowledge at present, is the corpuscle, self-organized, it is believed, from the ether and manifesting its sentient energy as negative electricity, causing magnetism, also light, heat, and other phenomena.

As the present evolution of matter proceeded, the corpuscles grouped themselves, seriatim, in the atoms of the so-called elements of matter, the gases and liquids, the metals and other substances, with their varied combinations of atoms in molecules; in a word, matter as we see it on the earth's surface to-day.

It has all gone forward under stress of that primeval, sentient impulse to move. There is no other rational explanation of creation or of the universe. It is a self-moving

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universe and the impulse is from its own initial sentience. In a lowly sense the corpuscle is as much a living being as is the cell-of-life. Atom and molecule, too, each lives its life, some of them, indeed, possessing a degree of immortality. The difference betwixt the life of an atom of oxygen and that of a brain cell is one of degree only, due to a more extended organization. It is all life.

And this universal, sentient unity, shall we call it God? Not in the anthropomorphic sense. It does not seem proper to deify it, or worship it. Its life is lowly, unintelligent energy; purblind, unorganized sentience. Yet out of it omniscience and omnipotence may issue, through self-organization, first of the corpuscles in the atom, the atoms and molecules in the cell-of-life, cells in the human organism, and human organisms in the larger life of the race. God is therefore ahead of us, not at the beginning. Omniscience has yet to come. Omnipotence is in the future, not in the past.

Godlike and immortal beings may have developed in past eras and cycles of the cosmos. If so, they would seem to have passed to other quarters of space. Within the flight and range of light and gravitation, we find nothing operative to-day save matter and its sentient energy.

If there is a God behind nature, he now gives no token of his presence save nature itself; and it is more logical, more reverent, if reverence be exacted of us, to conclude

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that we are not to seek what we have no means of finding. "God" is not on this side of matter; and what is on the far side, we know not. Moreover, it is as rational to think of the universe as having existed from eternity, as to conceive of a Creator who antedates it.

The low-sentient energy which drives nature forward amain, is plainly not regardful of animal life on the earth, nor the hopes and fears of mankind. Indeed, it is not easy to comprehend what this swift, impulsive, radiant life of unorganized matter is, in its relation to organized life which rises to intellect. Yet the one comes from the other. Everywhere above and below the earth's immediate surface, matter is seen to be largely in the corpuscular and atomic condition, actuated by a life and energy of such low degree of intelligence as scarcely to be symbiotic to the human mind. It lives vastly, voluminously, with enormous dynamic power, but is unconscious of man. Yet of its intimate nature we have ample evidence that it is true to an end, invariant, and hence beneficent to those who place their lives in accord with it. On the other hand, it crushes out remorselessly those who from carelessness or wantonness go counter to it. Remorselessly, because it recks not of human hopes or fears, and is not conscious, on the plane of human consciousness. To us and our intents it is largely impersonal. We have to learn of it and live by it. It is the eternal fount and well-spring of life and has immortality potential for those who

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will learn how to avail themselves of its possibilities. Otherwise not. We must learn how to live in accord with it. Immortal life is thus our birthright, under nature; but we must enter into it by our own efforts. It will have to be our own achievement. We are not saved, nor to be saved. We shall have to save ourselves.

In this our epoch of the cosmic evolution of matter, we see the sentient substance segregated into numberless little self-lives, microcosms within the great macrocosm, a vast cyclic movement toward individuality. The lowly sentient energy of the world-ether whirls itself asunder and apart into unnumbered little personal lives, each a self, living for itself in the midst of the environing universe; each subjective to itself, with all the rest of the universe objective. First the corpuscle, then the atom, each a living self and soul from out the primeval sea of sentient energy.

On the surface of our earth the atoms unite in the protoplasmic molecule, and these in turn combine in the cell-of-life, with its marvelous gift of memory and mentation. And after long eras of unicellular life, lo, the unicells combine in the multicells, the terrestrial, metazoic life now headed by man.

So far as we now know, the corpuscle is immortal, in the sense of living as long as earth and sun and stars abide. Certain of the atoms appear to be so, but not all. Some of them waste and die, or pass into other atoms.

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Can the combination of atoms in the protoplasmic molecule be rendered stable and deathless? Can the cell-of-life be perpetuated? Can the organized groups of cells in the human body be guarded, reinforced, and regenerated to the extent of avoiding dissolution and death? That is the present human problem of immortal life, the great work of investigation and research which we are now beginning.

An impossible problem many will say. But not in the least impossible. It can be done. We are, in truth, already well on the way to that greater knowledge of matter which will yield control of the cell-of-life. With united effort to that end, in America alone, it could be done in fifty years, and the gift of immortal life placed in the hands of those who were willing to live up to it. Who are willing to live up to it, we say. For immortal life under nature presupposes and necessitates a physical rectification, a personal continence, intellectual ennoblement and moral purification, such as are, at present, little known and practiced among men. Immortal life is an exalted life, not a retrogressive, aborted ghost-life; not a sinking back to "spirit" existence in the ether, but a going forward to a perfected organization of the protoplasmic molecule and cell-of-life. The entire course of the evolution of the universe, since sun and planets took form, is in earnest and evidence of this position. To grasp this truth and purge the mind of the errors of supernaturalism is the first step in natural salvation.

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II. Of the Cell-of-Life, Memory, and the Metazoons. — It is not certainly known how the cell-of-life originated on the earth's surface, nor yet that it may not have come to the earth from some other planet or sphere in space. In all probability it originated on the earth, during an early geologic epoch. For gravitation, the electric tension and the chemical affinities at the earth's surface, admit of a grouping of certain atoms and molecules — those of oxygen, hydrogen, carbon, nitrogen, sulphur, and phosphorus — in a larger molecule, or organization of atoms, which exhibits a more complex life than that of the component atoms. Moreover, this vivific molecule is so internally mobile, so structurally at an equipoise, that it is capable of receiving, sustaining, and retaining sensory impressions from the external world; that is, it can be acted on by its environment and retain traces of that action; in other words, it has the capacity or faculty of memory. It *remembers* what goes on about it.

The evolution of life on the earth founds in this internal mobility of the molecule of "protoplasm," so-called, the faculty of memory and mnemonic development. The cell-of-life, the earliest protozoon, was an organized aggregation of protoplasmic molecules. The development of intelligence in the cell, from the primary, sentient property of matter in its lowest form, presupposes this faculty of memory in the protoplasmic molecule.

What the physical or dynamic process of memory is,

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we do not as yet know; but the later knowledge of matter leads to the hypothesis that it is a change of relative position and *charge* of the atoms of the protoplasmic molecule, and that it is accomplished by currents of corpuscles, or of the ether, setting into the molecule from without. And by ether here we mean simply a medium or attenuation of matter, more minute than the corpuscle. Of the existence of such more minute attenuation there is now good evidence. In fact, the present hypothesis is that there are many such attenuations, one within or below another, as the corpuscle is below the atom, going down to more ethereal states not yet possible of demonstration.

The strong probability is that the protoplasmic molecule originated in the order of nature on the earth's surface, and that the cell-of-life — the protozoon — was self-developed from combinations of these vivific, life-bearing molecules.

Through a long period, not less than a hundred millions of years, the protozoons were the sole inhabitants of the earth. Metazoons, grand organizations of cells, were to appear in time; but during all that long period, there is no trace of them in the slowly accumulating strata. We find unicells only, each living its small life, and giving birth to offspring, usually by simple fission of the parent cell into two child-cells.

As to the psychic character of that simple unicellular

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life, we have abundant evidence that it was the minute prototype of animal and human life. For the cell-of-life possessed the faculty of memory in all its component mobile molecules, and memory is the one condition requisite to the growth of intelligence and mind. Every protozoon possessed a mind, a soul, quite as much as does an animal, or a man. The difference between the cell soul and the human soul is one of degree and quantity, not of intrinsic quality; and that difference of degree is due solely to the more extended organization of the animal brain.

The higher human faculty of thought rests on the more complex organization and greater mass of the human brain; it is not a difference in psychic quality. Memory and thought are carried to higher, more complex reactions in the brain of an animal, or a man, than in the nucleus of a cell, that is all.

And how is this life of a unicell composed or developed from the basic sentience of matter? The answer to the question is of interest, since it strikes the key-note to the origin and destiny of the human soul.

First we have the corpuscle, living its electric life; and we find from ten hundred to two hundred and twenty-four thousands of these individual corpuscles pooling their lives in the life of an atom, such as compose the various elements of matter.

The life of an atom is a consentient *blend* of the lives

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of all its component corpuscles, where each *gives up self* in the larger life of the atom. There is self-surrender in the interests of the larger life.

It is this faculty of pooling individual lives in a larger life which has led the most acute of our scientists to conceive the hypothesis that, at bottom, matter when at its lowest attenuation, is a confluent Unity; not segregated, but capable of segregation, an unorganized, etheric world-fluid, to wit, sentience, or sentient energy. The semblance of form and substance begins with segregation.

Whether this hypothesis be true or not, the fact is well established that the corpuscle has the faculty of pooling its life in the larger life of the atom, the atom in the protoplasmic molecule — where memory is possible — and these molecules, in turn, surrendering self in the greater life of the unicell, where true psychic faculties are exhibited.

The unicell lives, hopes, fears, and erelong suffers death, from the inevitable concurrent accidents of its environment; and at death, which is by no means the death of the component atoms and corpuscles, these same atoms and corpuscles reassume each its own individual life and go their ways into other cells, or other combinations of matter. Such is the rationale of cell life, and it offers us the key to the greater problems of human life.

Owing to accidents from the environment, the unicell of the ancient earth lived but a short time, a few hours, a few days, it may be; but from the psychic side of its life,

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it was always seeking to escape death; for that is the nature of all life. And at length, after all those millions of years, we find the unicells combining in cooperative unions.

As to how this was first accomplished, we have as yet no knowledge: whether cells became banded together, as seems quite possible, or whether from some intracellular evolution of the protoplasmic molecules, a double- triple- or multiple-celled creature was first developed. The fact remains that multicellular creatures, metazoons, appeared on the earth; animals in which we find one tract or group of cells doing one thing, for the common good, another tract or group doing another; differentiation of function, in fact. One cell, or group of cells, acts as eye for the whole union, another as ear, others as muscle, still others as bone; others still as organs for food preparation and carriers of the prepared food; while yet another interior group assumed the function of intelligence for the union, the office of perceiving, reflecting, and deciding what is best for all to do; in a word, the kingly function of brain.

To do this the more effectually, the brain cells found it necessary to put themselves in sentient touch with each other, by means of intercommunicating and interlacing protoplasmic fibrils, so as to be able to sense, feel, and act together; and as these cells of the intellect had the whole cooperative union to direct, govern, and care for, they

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found it necessary to put forth long filaments to every tract and group of cells; in short, a nervous system, extending to and throughout the whole organism.

Such, in brief, is the animal or human organism, thus developed from the unicells of the ancient earth. Tremendous advantages accrued from it to the cooperating cells. In unicellular life, they suffered from constant accidents and lived no more than a few days, at most, but in the cooperative, organized life of the metazoon we find brain cells, bone cells *et al.*, which live for a century or more. By thus uniting and living together in a larger life, these cells, descendants of the olden unicells, have achieved what to a cell is well-nigh immortal life.

How is this union or pooling of individual cell lives in a larger life accomplished? Not by the obliteration of the cell self, but simply by placing the self in line and in chord and consonance with its associate cells, as when many laborers place their shoulders to one wheel, or pull at one drag-rope, or lift together, to raise a heavy timber: the union of the strength of many in one impulse, to raise greater burdens and accomplish larger results. There is no loss of the self life, but united action with others for the ultimate benefit of that self life. Each cell retains its individuality and, in a sense, its personality. Each lives its life, but lives it in the larger life of the whole animal organism. When thus banded together, there is ensured to each protection from many of the accidents which befell

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the small unicell, better food and the benefits and advantages which accrue from the greater experience and organized knowledge of all. In all these respects the analogy between the cooperative cells of the animal body and the citizens in a republic, or nation, is very close and instructive.

And what a lesson is taught by this grand achievement, on the part of the protozoons! In the animal organism the whilom unicell has found a natural salvation; and even so human beings may achieve immortal life and make earth heaven, by organized cooperation in research, invention, and the mastery of the resources and powers of the universe. Slow and blind, indeed, is he who does not grasp the significance of this great effort of unicellular life. Even so must the sons of men achieve a natural salvation from disease, "sin," and death. It is the great lesson of the ages. Humanity must unite, organize, and cooperate, to grow in knowledge and gain control of nature. Such is the promise of science. Thitherward lies "heaven" and immortal life.

But mark well the principle on which this grand development of cell life in animal organisms rests; the principle of union, cooperation, organization; the building-up of a larger, organized life from many smaller, less complex and hence less intelligent lives; first, the living corpuscle in the atom, atoms in the protoplasmic molecule, these

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molecules in the cell-of-life and cells in the animal body; a grand evolution of a larger, more intelligent life from millions of lesser lives.

Mark it well, for we must not ignore the sequence, nor shut our eyes to what inevitably and logically happens when that organism of animal life is marred, dies, and is dissolved. There is no final loss, no death, no cessation of the basic life, itself, meaning the initial sentience of matter. The instinctive faith of humanity that life itself is intrinsically deathless, has never been wrong; that basic life goes on otherwise and in other forms of matter. It is the union, the larger, cooperative life of the animal which is dissolved and ceases to exist at organic death. The atoms and corpuscles then separate and go each their ways elsewhere, taking each its individual, inseparable life with it.

The union is dissolved; the cooperation ceases; the organized animal life is no more. The components of that life, the corpuscular and atomic lives, go on in a myriad other new forms and aggregations of the universal life. There is no cessation of that universal life, but a passage, a translation, into new forms.

The problem of self-life lies in keeping the organization; in the words of the old axiom, in keeping soul and body together. Otherwise, it is resolved back into the lowly, unintelligent life of unorganized matter. When we die we are still a part of the great whole, but not as an

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organized self, not self-consciously. We are still here, but we do not know it.

III. In the Larger Life. — The present social evolution of mankind in national life is so clearly a continuation of the metazoic development of cell life, in its progress toward natural salvation, that students of social science will find great help in using the animal organism as their model for study. The analogy is very close, the similitude striking.

National, civilized life — the later, larger development of life on the earth — has not yet gone so far relatively in organization as metazoic life; the individual citizens of the nation are not yet as fully organized and united for cooperative effort as are the cells in the animal body; that is the only point of difference; the principle, the *motif* for uniting, is the same. Even as the unicell was too small, too weak, to live long or happily on the earth's surface alone and unaided, so with the unorganized human life. To gain better, happier conditions, there must be organized cooperation in a larger, stronger life, the communal life of the nation, or of pan-humanity, in which self is not lost, but ennobled by consecration to the common good.

From the corpuscle upward to the cell, and from the cell upward to the human organism, there has been no loss, no obliteration of self life, but a consonance, a

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banding together, to secure stronger effort and greater advantages for all.

Even so in the perfected republic of the future, the individual citizen, by a full, generous cooperation with his fellow-men, will attain the domination of nature, and in the end, freedom from those evil conditions which now uniformly cause death after a brief lifetime.

In this larger life of the nation and of all humanity we live, per force; and it is to the still untaught, futile struggle of the individual man to live for self alone, and make his environment subserve his own selfish ends, that nine-tenths of the unhappiness, misery, and crime which we see about us, is due: the effort to live for self alone. In this we have great need to change our present ideals of personal life and our conceptions of what our lives are for. In the very cradle, we now take a wrong apprehension of what we have come into our heritage of life to do; a wrong apprehension which comes from erroneous beliefs concerning the nature and destiny of the human soul. At the outset of life there is dinned into our infant brains the falsehood that this earth is but a dreary bourne which we are soon to quit and fly away from, instead of becoming a part of its greater life. Largely due to this initial falsehood, we find the majority of mankind living solely for self, devoting their energies to getting the largest possible share of humanity's hard-earned wealth, by hook or crook, often by any species of legal trick or dishonesty.

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Yet even as they grasp the prize, the curse from it falls on them and their sons. It is the logical result of the initial untruth, told and sung to the cradle. The child's ideals go wrong from the start. Most of all we need a system of instruction for our children, based on natural truth, versus the present supernaturalism; such a system as Japan is now seeking for its unborn posterity; instruction to live in the Larger Life.

Well-educated people in Christian countries to-day, in England, in America especially, are in the anomalous position of teaching their children for the first ten years of their lives an antiquated supernaturalism which by the time these children are fifteen years of age, they have infallibly to unlearn and reject!

Mind is a growth, a progressive system of molecular architecture, an orderly building of the protoplasmic molecules of the brain cells. We allow to be reared in the brain of the child, at its most impressionable age, when the cerebral cells are most plastic, an edifice of error which, a few years later, has to be razed from its foundation and a new structure reared there on wholly different lines, fronting a different aspect of the universe.

How many of us know, too, with what mental misery and with what keen pangs of conscience this demolition proceeds. Such potent hold and sway over the brain have first teachings when given us by fond parents and venerated instructors!

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What wonder that in so many cases morals suffer and a hard unbelief in everything religious supervenes? It is the natural reaction from the Falsehold told to the cradle.

The psychic and physiological damage done the brain by this disaster to its first hopes and beliefs can be but inadequately demonstrated, as yet. To start the growth of a human mind wrong in its essentials, at the outset of self-consciousness, is the most serious of handicaps.

With Romish and Greek Christianity (as with Mohammedanism and Buddhism) the system of tenets has passed into the *rigor mortis* of a dead faith, and become structurally unprogressive. Such creeds, like old trees, may die, but can not be rejuvenated. Much the same is true of the elder Protestant sects.

We have ever to bear in mind, too, that church Christianity, as we now see it, is Christian only in name. The Personage, called Jesus, who lived nineteen hundred years ago in Palestine, conceived himself to be the Hebrew Messiah, and sought to found a Kingdom of God on the earth, the denizens of which, he taught, would be immortal through purity of heart, meekness, mercy, unselfishness, brotherly love, righteousness, and right living generally. This is evident to all who read even the present perverted, gospel histories, with an unbiased mind.

Supernaturalism, with its tenets of disembodied soul

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life, nether worlds and upper worlds, was grafted upon Jesus' simple, beautiful scheme of immortal life, by church synods and conferences, for politic purposes.

That simple, beautiful scheme of deathless human life, taken by itself, stands forth as fine and true as ever; for it is natural truth. Did Jesus perceive intuitively what it has taken science so many centuries to learn? One might almost think so. In no respect, in no particular, not even in spirit, is the Messianic scheme like Romish, Greek, or Protestant Christianity. When the church adopted Zend-Avestan supernaturalism, it lost Jesus by the waysides of Judea.

Much the same, in fact, is true of Siddartha and modern Buddhism. As creeds, each has evolved itself clean away from its founder and is now practically an alien cult. Church Christianity to-day has absolutely no claim on the believer in Jesus, and no right to the use of his name. Humanity is now turning again to the man of Galilee, seeking to find out what he really taught; and what that was we shall never learn in a church that now bears his name!

Only in the most highly figurative and metaphorical sense do any of the old creeds even approximate truth as we now know it; and as embodiments of the moral and so-called spiritual life of humanity, their claims to veneration and support are greatly exaggerated.

What we most need is to sponge off the slate of human

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faith and write down on it a new equation of the truths of nature, for ourselves and for our children.

It is at this difficult phase of human progress in America, that we now stand hesitant, loath to break with church Christianity, yet convinced that its dogmatic teachings are erroneous. Convinced, too, that when the break comes supernaturalism and everything connected with it must go, *in toto*.

Far more, even, than our clearest minds are aware, our lives enter into the larger communal life of the race. All of history, science, and intellect in the higher sense, is due to the reflex action of this larger life on us personally; all that distinguishes the educated man of our times from the bone-cave savage of the Quaternary drift — whose radius of activity described only a four-mile circle around his filthy cavern, whose days were passed in ferocious hunts for food, his nights in shivering fears of attack. Who heard the foot-falls of evil spirits behind every bush, saw gods on every hill, and whose religion consisted of rude rites and sacrifices to propitiate these. Who dreaded with good reason the approach of his fellow-men, and whose highest feats of strategy lay in ambuscading and massacring them.

Such was primeval man as we first know him — a roving, lurking, unorganized human protozoon, with a mind no higher than the brute. Altruism was as yet unborn

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in his brain, the advantages of cooperation undreamed of. Whatever we are better off than that bloody handed hamadryad of the bone caves is due to our communal life.

It is owing entirely to that life that we can travel in ease and safety far from our primitive caves, even around the world, and secure to ourselves the cultivation which comes from such travel. It is due entirely to our co-operative life that commerce goes on and the fruits and goods from every quarter of the planet are brought to our doors; that railways link country to country, and steamship lines continent to continent.

It is due to our communistic life that we have literature, history, science, and the news published for all from day to day; that the sea is underlaid with telegraph cables, the land overspanned with wires, which put us in thought-touch with our fellows, thousands of miles away.

To this larger life, too, it is due that remedial, surgical, and sanitary science has developed and now adds so much of comfort and assurance to our lives. To the larger life, that invention, architecture, and all the arts have made life comfortable.

To this larger life, also, that ideas of right and wrong, justice and injustice, are able to find expression in public sentiment and take the form of law for the equable protection of all.

All these, however, are but the outward and super-

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ficial aspects of the communal life. Its preeminent influence and effect are on the mind, the brain, of the individual. This greater life, with all its varied interests and many businesses, holds us up to a certain key or pitch, lifts us to a wider horizon. Isolated from it, the individual man would soon relapse to an inert, sluggish creature, caring for naught save sensory pleasure — in a word, to a savage. It is the larger communal life, yielding a constant influx of knowledge from all quarters of the globe, which now develops the individual man, raising him to higher degrees of intellect; not otherwise than in the metazoic organism where the larger life of the man or animal elevates, improves, and strengthens the life of every tissue cell, raising up brain life from simple protozoic life.

In the case of the human body, there is an *aura* of consentience, of the nature of an electric "atmosphere," or field, the sub-conscious life, in the grasp of which every cell of the organism lives and is maintained at a certain key or tension. Nor can it be doubted that something like this is present in the case of national life made up from citizen life. There is a national *aura* within the "field" of which each citizen lives, the sustaining, invigorating influence of which he feels for good as long as the nation is progressive.

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IV. Of the Human Brain; Mind; Intellect.—In those great organizations of cell life, the bodies of animals, now headed by the human organism and human life, our interest naturally centers in that tract or group of cells which, in the division of labor, has assumed the function of directing, controlling, and governing the other groups; that superior group which took upon itself the function of intelligence, and organizing slowly along that line, as ages passed, has developed into the human brain and nerve system.

In the animals and, preeminently, in man, we find this group or genus of cells — descendants of earth's primitive unicells—lodged in the skull, walled about for safety with bone and tough integument, but in excellent communication with the external world by means of the organs of sight, audition, smell, and general sense. Provided also with a matchless apparatus for conveying its intelligent behests to all the other associated groups of cells. Histologically, too, when examined with high microscopic powers, we find this entire brain group of cells organized as a unit of intelligence by means of affiliating fibrils and filaments of protoplasmic matter which enable all these millions of cells to *feel* together, *sense* together, act together, and live consentiently in one greater life, the organized operation of which we term the human mind.

A study of the human brain shows indubitably how this unification of sense is accomplished and the mazy organi-

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zation on which it rests. It is at once the most complicated, the most complex, the most wonderful development found anywhere in nature ; and from it issue the most wonderful results, to wit, the human intellect. Yet it has all developed and come up by self-organization on the part of this group of cells whose ancestry is the unicellular life of the ancient earth.

Moreover, and a point of great interest to us — as is shown in a subsequent paper — the brain cells and brain, as a tissue of the human organism, is a still progressive tissue. Its evolution has by no means ceased ; it is still growing larger and developing keener intelligence, from generation to generation. Whereas, otherwise than in brain, the human organism is not much better than it was three thousand years ago, nor much better, if as good, in some respects, as are certain of the lower animal organisms in muscle, bone, and digestive tissue, yet in brain it exhibits an immense and a still growing superiority. So much so, so remarkably, that intelligent interest in the evolution of life on the earth, has come to center in this extraordinary group of cells. They are the one great progressive group. The rationale of this seems to be that for some reason, far back in animal life, the brain of the ancestral anthropoid was driven to think, that is, to exert itself more vigorously or constantly than previously ; and that having begun to think and gain advantageous results from such exercise, these early human brains have gone

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on doing so, till at length man possesses a larger cerebrum which looks forth intelligently on the external world, scans the entire universe; in fact, invents, adapts, and plans the complete mastery of nature.

For it is a mistake — one which not a few biologists have made — to conclude that the brain of man will remain subject to the ordinary courses of nature. It tends to master and control nature, to impress chemism and all the natural forces into its service, bend them to its will, and even to reverse and suspend their operation.

The labored, fatalistic theory of Weissmann assumes that nature is fate for man, and cannot be changed by man. Whereas nothing is more evident than that man is now constantly changing the ordinary course of nature, bending it to his will.

To Professor Metchnikoff of the French Institute, "old age" in man is something final, to be accepted with resignation or stoicism. All that can be done is to rid the human organism of noxious bacteria, perfect surgery and choose food with greater wisdom. By so doing we may, under favorable circumstances, prolong human life thirty or forty years, possibly sixty. No hope of anything better than this ahead.

Has the new knowledge of matter no significance for this savant whose genius and industry we so profoundly respect? Does he not lack the proper intuitions of science?

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To-day we are on the very brink and verge of discoveries that will enable the cell-of-life to be regenerated at will. Nature is no longer fate for science; science will be fate for nature. We are soon to master it and do with it what we please. There is deathless life for man, ahead, without "old age," or infirmity.

But how? By what steps?

Verily the first step is faith that it can be done; for in good truth "it is the spirit that quickeneth." Hope and faith light the candles to human achievement. And this great achievement will come from the combined efforts of well-instructed minds, working together. Here, as nowhere else, cooperation and united endeavor will count.

Three-fourths of the human race at present perish directly or indirectly from the attacks of noxious unicellular life; but the problems for alleviation are already outlined and on the road to solution.

Another factor will be climate control; regulation of the solar heat on the earth's surface, its conservation and equable distribution and storage, in place of the present evil natural conditions, with furious atmospheric disturbances, erratic electrical tension, disastrous drouths and unregulated rainfall. Science looks to control it as perfectly as a modern filter. It is a purely physical problem, with no unknown factors.

Again, the "old age" which our French savant believes to be a final law of human life is largely the

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secular result of imperfect food, imperfect nutrition, the errata of digestion, oxygenation, and assimilation. In a sense, so much food ingestion, so much "old age" as a result of faulty cell-nutrition. Ten years of research, directed fully to this end by a thousand well-equipped investigators would give us pure foods from chemical synthesis, on a basis of the corpuscular nutrition and restoration of the protoplasmic molecule. Foods which would leave in the organism neither ash nor detritus. What science now has in view is a perfected chemical nutrition of the cells. And this might come soon but for our present lack of faith, conflicting views, and, alas, conflicting creeds.

Still another problem of "old age" to be investigated with good hope of a successful solution, is the regeneration and renewal, *in situ*, of those groups of cells which produce the variously associated tissues of the organism. These tissues and organs grow to their normal type dimensions, while yet the component cells are adolescent, then pause in maturity and continue in a condition of non-growth till at length the specialized cells which produce them become sluggish, pass into a condition of desuetude and are "bound out" amidst their own hardened products. We have before us the task of devising some process of preserving these cells and keeping them active.

In the case of broken bones and wounds, these inert cells are seen to possess notable powers for restoration.

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In old bone cells and old muscle cells, what seems to be lacking, is field and opportunity to resume function.

V. Of Reproduction and Continued Life.— We do not yet know with certainty whether reproduction in animals and man sets up a draught of protoplasmic molecules from all the cells of the organism. By this we mean an exhaustive draught on the cell, draining away from it into ova and spermatozoa, living molecules of the nature of Spencer's "physiological units," Darwin's "gemmules," or Weissmann's "biophors," which are at present irreplacable; and hence that old age is a condition of depletion and exhaustion, which ensues normally from the possession of reproductive organs.

A later view is that the draught to the reproductive cells is not of the protoplasmic molecules, but of bodies far more minute, the seed of these molecules, so to speak; bodies of the nature of ions; a peculiar kind of atom, the seminal atom, which accumulates normally in the reproductive cells, each atom capable of growth and development into, first, the protoplasmic molecule, then the cell and, in due season, the parent organism.

Thus far the evidence is in favor of the view that there is no draught to the reproductive cells, which can not be replaced by normal healthy cell life; in short, that "old age" comes from other causes than reproduction,

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VI. Of Mental Old Age. — In animals and man the mind, meaning the self-sentient *form* which memory and life-experience give the brain, also grows "old" and exhibits lack of sensibility.

Memory is a sentient reaction between the living protoplasmic molecule and the external world. Life as we live it, molds this mobile molecule, leaving in it a wonderfully enduring record from without. This mnemonic tracery increases in complexity as years pass. Yet it would be a mistake to conclude that memory and mental growth are merely so many impressions stamped in the brain.

Memory presupposes a sentient reaction in the brain as well as impressions of what take place about it. In the case of repeated impressions, day after day and year after year, from the same cause, scene, sight, or sound, there is constant reference to the former impressions, with gradually lessening reaction. It follows, therefore, that an animal or man, living amid the same scenes in the same locality, through a long period of time, tends to grow dull to them and exhibit mannerisms of speech and movement.

It is a matter of observation, however, that when such a person goes into a new place, a new country, and encounters fresh, novel experiences, the former mannerisms slowly disappear. Yet earthly life at present, under almost any circumstances, has much of identical routine, the daily corporeal experience of labor, sleep and waking, food, drink,

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and digestion, all of which tend to cell-monotony and restrict mental growth.

Greatly prolonged life presupposes that progressive growth of mind for which the universe so plainly affords field and opportunity. The human mind is now stunted to a condition of "old age," from lack of field to grow, and rise to higher planes of thought. The average human brain is capable of such growth when the fitting opportunity is afforded it; and progress of this sort always tends to obliterate former out-worn planes of thought. Human beings, however, have but just entered on their grander epoch of mental progress. Brain still tends to "old age" shortly after the adolescent and reproductive period is passed, but this largely from lack of field and opportunity for further growth. Immortal life implies immortal growth of the personal intellect. The universe offers an illimitable field. We have but to enter it.

VII. Of the Dissoluble Nature of the Human Intellect. — Throughout nature, everywhere, we see life rising by successive steps of cell-organization and cell-cooperation to higher and higher degrees of intelligence. Organization of the sentient substance of which the universe is composed is the method and the way up to intelligence, to omniscience, and omnipotence.

On the other hand, nature, in her evolution of life, has put forward no plan and made no provision for the saving

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of the composite, organized life of a metazoon, an animal, or a man, when by accident or disease the organism is destroyed.

Yet self-conscious life everywhere shrinks from death. On this fond, sad hope of a dying world, Supernaturalism has preyed for thousands of years, with its thousand empty promises, in return for tithes, rites, and tribute. That is the burden of Asia's superstitions.

To-day the growth of human knowledge brushes aside all these fond, vain hopes of supernatural rescue. They were but the mirage, projected before the eyes of a race of beings that had begun to feel the cruel hardships of death and seek salvation from it. Supernaturalism marks an initial phase only of the world-wide effort of mankind to gain immortal life. It seems to have been the first purblind step. An illusion, but one which none the less had promise in it, promise of a future, grand achievement. In place of it science now points out the facts of nature, and shows the way to a *bona-fide* immortality.

And is it not the part of wisdom and of duty to choose this more certain way? Why longer build our hopes on that idle myth? True, a venerable creed, redolent of incense, endeared by ancestral worship, entrenched in costly church architecture and embalmed in sacred literature, exhorts and entreats us to trust the myth. Half the world still tries to believe, while the other half scoffs, or turns its face to other things. The plain truth is that

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the brain of the race has outgrown the myth of "spirit" life; the facts are too evident.

For what occurs when an animal or a man dies? The heart ceases to beat. The blood stream to the brain stops. Well-nigh instantaneously the brain cells lapse from consciousness, retract their fibrils and relax sentient contact cell with cell. The personal self-consciousness as suddenly ceases. The organism is no longer a living man, but a cadaver. Immediately then it is invaded by swarming hordes of putrefactive bacteria, and the work of dissolution begins; nor ceases till the organized *corpus* is reduced to the component atoms and corpuscles from which, by so long a labor of ancestral life, it had been raised up to be the mechanism of intellect.

It is the organism, the organization, alone, which has perished and ceased to be; but that organization carries the personality, the self, the self-consciousness of the man. Each atom and corpuscle lives on, and, departing from the dissolving cadaver, takes its individual life with it. Apparently these atomic and corpuscular lives are deathless. We thus live on in the elemental life of the cosmos, from eternity to eternity. We were a part of it from the beginning, and shall be a part of it on to the end, but not a self-conscious part.

It is thus the elements of the human soul only that are immortal. We are not saved, personally, under nature, but have opportunity to achieve salvation. There is

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liberty to do so. Supernatural salvation is a myth of the world's childhood. But now in the light of greater knowledge we are free to work out our own salvation here; and the new faith of science bids us do it.

VIII. The Normal Optimism of Nature. — The attitude of mind which the growth of scientific knowledge sets up is emphatically one of good-will, hope, and great expectation for the future. On this planet, after nature's myriad experiments in living organisms, brain, the brain of man, is now making a noble progress. That wonderful colony of living cells, organized to grow in knowledge, is now taking grand strides toward the conquest of nature and the universe. Pessimism as to this is but ignorance of the scope and extent of that progress. It has been persistent, continuous, irresistible, for a hundred millions of years. Apparently, too, it is now but well inaugurated; and field appears to be offered it by the natural life of the globe.

Barring cosmic accidents in space, the earth, like Mars, Jupiter, and the other planets, bids fair to revolve for millions of centuries to come. Water and air, too, show no indications of depletion. The well-springs of solar heat, light, and electricity are equally enduring.

Moreover, these tides of energy from the sun can be conserved and their action on the earth's surface regu-

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lated. Climate can be controlled and the planet made a paradise. It is an empire waiting for human conquest.

The one element which individual man lacks to enable him to conquer this empire and enter into possession of it is time. Individually, his days are now too short for more than to learn the first rudiments of life, and perceive his real situation in the universe. There is not time for more. Before we have fairly learned to live, we suffer from disease and infirmity, and die, miserably die, with all this infinite opportunity to live, unentered, unenjoyed, unpossessed. Death keeps humanity down to a bootless learning and re-learning, over and over, of the mere alphabet and accidence of life. On account of death the human generations but little more than hold their own; for in dying the results of teaching are almost wholly lost. But little of experience is really conserved; for the tissue of intellect must mature for forty years to become really wise. Death causes all this vast labor to be done over and over again, on the whole a little better. Reproduction is better than extinction, but only a degree better, and not for a moment to be compared with the grand advantages of living on, free from personal death.

Reproduction takes place because we should otherwise die, but it is not an ideal mode of survival. The individual with his acquired experience and refinement is the ideal survivor. Infancy suffers what would be needless

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tortures in learning to live, if the adult could survive in health.

The world-wide demand of educated, inventive man is now for more time. He sees the doctrine of disembodied souls to be a myth, and asks, Is it possible to save the soul? The question is one that enters with the newer conception of our freedom in the universe. What we have we must achieve for ourselves. We are alone here, with everything to gain from invention, research, and discovery.

Immortality is the birthright of life and the destiny of man. Men still die, but death is not an irremediable evil. The great terrestrial scheme of life, when grasped in its entirety, points to a purified earth, inhabited by one great nationality, the descendants of mankind, whose lives will be prolonged toward immortality. A *gens*, terrestrial and celestial, not overpeopling the earth, nor yet devoid of procreative power; not an assemblage of infirm, aged organisms, kept alive by improved medicaments; but persons fresh in unfading maturity to whom the years will bring, not infirmity, but stronger personality, fuller life, grander beauty, and greater wisdom. For this wonderful substance which we from eternity inherit — and now call *matter* — has in it an infinite potency and capacity: the capacity for godhood if we will develop it.

The new and greater gospel of science, as briefly outlined in the foregoing paragraphs, is therefore this natural

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optimism of the human heart, this faith in future man, this ennobling surrender of self in the larger life of humanity, and lastly, grandly, this new hope of immortal life, achieved in righteousness, on a perfected earth which shall realize our ideal of Heaven. This is that grander faith which three centuries of science now offers mankind.

The effort to set forth this new view of immortal life is, as the writer is most painfully aware, but a crude one, burdened with all those imperfections which usually attend the first annunciation of a new cult.

An attempt to call attention to these remarkable aspects of cell evolution, was made from this laboratory in 1888, again in 1892, and yet again in 1896. It was not, however, until the first edition of *Natural Salvation* was published, in 1903, that my fellow-workers in the world of science vouchsafed anything like intelligent recognition of the effort; and even now, so strong are the shackles of old creed, their voices in assent and commendation are low and timid.

"You are wholly in the right," one says. "But don't quote me as saying so. My chair is in a Baptist university, you know."

In that pitiful frame of mind, sit many worthy scientists in our America of to-day. None the less this new, greater faith has taken firm root and defies eradication.

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NATURAL SALVATION.

THE MESSAGE OF SCIENCE.

IT is a part of the unwritten code of science that the investigator shall avoid *a priori* conclusions, look coldly upon theory, and be wary of hypothesis. In a word, that he shall devote himself patiently to the acquisition of data, be content to collect facts, and live abstinent of the ever-present human weakness to play the role of prophet.

Nothing, indeed, so surely distinguishes the man of science from the charlatan as his attitude toward theory and his caution in presenting conclusions. A single page, often a single paragraph, of the article, or the book of a writer on scientific subjects, enables us to judge all too accurately of the value, or lack of value, of his entire effort; and, generally speaking, the verdict turns on the care with which he draws conclusions from data.

Science has endured so much of premature vaticination that its best friends and exponents have come to regard all that sort of thing with marked hostility, as detrimental to true progress. There is a disposition to put injudicious

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enthusiasts outside the pale. A certain regimen has come to prevail; immature publication is held to be bad form as well as futile. Humility and an educated conservatism characterize the truly scientific mind: the attitude of Newton at the end of his grand discoveries.

With all that biology has of late demonstrated, we know too little still to say much of first causes; yet the time has come when the creed of science can be outlined and forecast.

It is in the nature and constitution of the human mind to believe something. The history of mankind shows that those tribes, nations, and races which have gone forward with the greatest energy, have been actuated and incited by confident beliefs as to the origin and destiny of human beings.

In like manner the scientist has often found hypothesis an adjuvant; for an hypothesis is of the nature of a belief. Some of the most signal discoveries in astronomy, chemistry and biology have been elicited under guidance of provisional theories. There is a use as well as abuse of hypothesis; and, moreover, the theories of science are often *bona fide* glimpses of truth.

So at present, when the old faiths are fading out, like ghosts at dawn, when venerable "soul doctrines" are falling into desuetude and discredit, glimpses of the truth come and will serve to light us forward in the great outer darkness of the universe.

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As such and such only are the present outlines of a greater gospel put forward: glimpses of the truth, seen through the murk of our ignorance, but better certainly than the existent babel of superstitions.

As regards Christianity, biological science now goes far to substantiate and confirm the original scheme of life and salvation, as conceived and taught by the Founder, but will purge it and separate it from those adventitious doctrines which Church Fathers, Bishops and Synods engrafted upon the new religion during the first three centuries of its existence. These doctrines were never essentially Christian, nor even Jewish, but of the nature of ingrowths from Persian, Greek, and Egyptian systems of philosophy.

Christianity, however, can hardly be said to be more than one of the religious beliefs of America. Allah, Brahma, Joss, and Mormon, as well as the Hebrew Jehovah, are now worshiped among us. Asia and Africa, as well as Europe, have contributed to the amazing *mélange* of tenets which stand for religion in the United States. Never in the world's history has such diversity of belief been exhibited in one country; yet each of these hundred and ten different cults is endeared to thousands of immigrant devotees by ancestral ties and traditions.

If by some megaphonic device we were able to hear, at one time and in one place, the amazing outcry of doctrines which goes up in thousands of churches, temples,

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and other places of religious worship, the confusion would out-jargon that on the Plain of Shinar.

Such multiples of contradictory doctrines mutually discredit each other. It has followed naturally that the younger generation, born in America and educated in the public schools where general scientific knowledge is imparted, is quite without a faith, in the old-time meaning of that word, and looks to science for its real tenets.

Nor looks in vain. Even now, already, science is able to outline a new and greater faith; and no prophetic gift is required to assure us that this new faith will be the religion of future America.

For a new hope has come to the human heart, the hope of salvation from "sin" and death by natural means: *Natural salvation*, contra-distinguished from supernatural salvation. Supernaturalism has been the burden of all previous religious systems. In all the past, human hopes have founded on rite, sacrifice, and supernatural rescue. But the keynote and initiative of the message of science is natural salvation: salvation under nature, accomplished by the growth and conservation of human knowledge.

In all the past man has turned to the skies and prayed to powers beyond the earth for salvation; but now, at the dawn of the twentieth century, he turns to himself and gravely, hopefully estimates the problem of self-salvation.

Moreover, self-salvation, when regarded in the light of our present greater knowledge, is seen not to be new at

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all, but to have been in progress ever since life first found foothold on the earth's surface! Apparently it has been in the natural order of things from the beginning.

We shall be able to show that natural salvation has been the tendency and trend of the evolution of life on the earth; that from the Silurian ages upward, life has put forth and developed toward a naturally attained freedom from evil conditions, "sin" and death; and moreover that the prospect for this is good. There is so much doubt, disheartenment and pessimism in the world that a plain statement of the human situation from the biological point of view cannot be otherwise than morally healthy. The progress of this great life movement on the surface of the globe constitutes a drama of surpassing interest, the grandest spectacle in nature.

As to the origin of life on the earth, we have no certain knowledge as yet, whether it came here from some other world in space, or originated here from a capacity to live inherent in matter. The former supposition puts the question of origin one step farther away; the latter is the one to which all intermediary theories must ultimately lead; for life is the subjective side of matter, its personal attribute: that property which renders the "ion" a "psychon."

It is not difficult to believe that there are other planetary globes where life develops more easily and with less travail and duress than on our earth. It is not incredible

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that the first cell, spore, or perhaps still more rudimentary germ of life, arrived here from some other world. It has been held that the "molecule of protoplasm," so called, could not have originated on the earth. Cell life does not now come into existence spontaneously; and the inference is easy that the first unicellular life of the globe was from an implantation.

This conjecture once admitted, the next surmise might be that the earth was life-seeded by design, or from personal motives, on the part of intelligent beings inhabiting a more life-fertile globe in space. And it is more reassuring to think that such vital implantation was from beneficent design and to conceive of it as Divine. It is a moral contradiction that beings more intelligent than man should be malevolent. On this earth, at least, intellectual development does not tend to, or eventuate in, malevolence and cruelty, but rather in a desire to give happiness. By human standards, an omniscient mind could not be a "Satan"; yet we do not know what exists afar. To the normal mind there is not much in the present life struggle on the earth that indicates mercy, kindness, or beneficence.

There is no biological evidence, pro or con. The attitude of the universe toward life on the earth seems to be impersonal and neutral. Animal and vegetable life grows, bears seed and dies, unwatered, uncherished, unharvested. And while at first, owing to long indoctrination, this thought of uncherished neglect pains many

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minds, it must on reflection come to be regarded as a glorious heritage of liberty — the liberty of the universe.

As nearly as can be estimated there is on the surface of the earth, at present, "protoplasm" (meaning matter temporarily in that condition of reciprocal activity which we term "living matter") to the amount of 5,500,460,500,000 tons.

Temporarily in the living condition, we say. For a significant almost startling phase of it is, that this vast quantity of matter is constantly passing out of the living into the non-living condition. As often as once in six hours, probably, once in twelve certainly on an average, the entire five or six trillions of tons of protoplasmic matter falls out of the living into the non-living condition; and *pari passu* an equally vast weight of non-living matter is raised up to the living condition. It is believed that all, or the most part, of the matter which makes up the outer strata of the earth to the depth of many miles, has at some time or other been in the living state, and not once or twice only, but many times.

We may, indeed, go much farther and not exceed what is probable in supposing that in the great past history of the universe — a history of successive series of solar and planetary formations — matter has lived in an infinite number of forms and types of life from eternity, intermittently and alternately.

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For here it is significant to note the reversion of scientific opinion from the extremes of the dynamic hypothesis of *pure* force, toward the Newtonian idea. Light and also heat and electricity are not only dynamic, but material. Force, so far as we know it, is always associated with an efflux of matter.

The method by which this continuous passage of non-living into living matter is effected, is association and contact with previously existing living matter. The non-living must be infused into the living matter ere the non-living can be re-vitalized.

The intimate impulse which accomplishes this vast transfiguration seems to be a *subjective* one, resident in the "protoplasm" itself, or, in other words, in the matter which is, for the passing hour, in the living condition, and which sinks down from that living condition, while in the act of raising up non-living matter to its own level. The impulse, or working energy, is apparently a transgression of subjective sentience into matter-moving power or motion, effected at a great depth of atomicity, on that low plane where particles are able to move in response to a primarily sentient property which they universally possess.

It is from this low plane, or condition of tenuity, that "protoplasm" is built up, and sets forth in its wonderful career. On the earth as we now inhabit it, life struggles upward from this deep-lying, sentient plane of matter in

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the teeth of a gigantic resistance. The energy in protoplasm is largely expended in overcoming this molar resistance; the bulk of our living substance has necessarily been impressed into mechanical service, — bone, teeth, hair, cuticle, muscle, tendon, in order to make way and obtain food. This, in fact, is life on earth, as man has thus far led it; but it is possible to improve the earth as a theater of life, and by the control and regulation of its "natural forces" to lessen the resistance.

Growth is a law of living matter; and on the earth's surface protoplasm is capable, under ordinarily favorable circumstances, of increasing its bulk much more rapidly than it wastes, or dies.

It is able to conserve energy. A cell is capable of raising up a greater amount of non-living matter into the living condition than it loses from the living condition by the act of so doing.

The only limit to such growth is the capacity of the earth as a field for life; it constantly sustains as much matter in the living condition as it has room for. The various genera and species of living things, moreover, mutually limit and restrict each other. But for animals, plants would probably overrun the earth to the full extent of its standing room; but for some species of animals, others would increase inordinately. Bacteria, in a favorable medium, propagate at a rate of which no conception can be given in figures.

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The point of interest concerning this is that, given favorable conditions, with no checks to its growth, the tiniest dot of protoplasm might convert all the available matter of the universe into protoplasm! or, in other words, when once a *modicum* of matter, ever so small, has entered the living condition, it has the power to draw an infinite quantity of contiguous matter into the same life-expressing combination, and continue the process indefinitely. It is as if the universe of matter were combustible and the dot of protoplasm, introduced into it, were a spark of fire, — with this important difference, however, that growth of living matter implies the raising up of matter to higher degrees of complexity, or the storing up of potential energy in matter, the reverse of igneous combustion. While we cannot affirm that growth of protoplasm is creative of energy, it is certainly conservative of energy in a manner elsewhere and otherwise unknown.

In protoplasm, a higher or more primary attribute of matter, to wit, *sentience*, appears to make heat, light, and kindred modes of energy its servants and to successfully stem the ordinary effects of katabolism.

In past ages of the world, noticeably the carboniferous, a far greater quantity of matter has been in the living condition at one and the same time than at present; the indications are that there have been periods when the continents sustained twenty times more vegetable proto-

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plasm, year by year, than during the present era. From age to age the quantity has varied in accord with the terrestrial conditions.

As yet we know no method of transmuting non-living into living matter apart from the agency of previously existent living matter. But no more can we at present make feldspar, or mica, or gold, or silver, or lead. It is as likely that we shall discover a method of producing living matter, as that we shall learn to produce any of these substances. The task waits a deeper knowledge of matter, but is impossible only for the present.

One reason for believing that new protoplasm and new protozoa no longer come into existence spontaneously, is that many or all of the micro-organisms which we study under the microscope are new only in the sense of being newly discovered by us. Many of the disease-bacteria were at least operative and produced the same poisons three thousand years ago. The diatomaceæ of to-day exhibit the same characteristics and the same silicious envelope as those taken from fossiliferous strata laid down in the seas of the tertiary epoch. In fact, many of the genera of micro-organisms are the most venerable and changeless of any upon the earth. Nor can we wholly agree with those who regard these minute creatures as the most rudimentary of living forms. It by no means follows that because a living creature is small, that it is hence exceedingly simple and recent in the sense of ancestry and heredity.

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Another feature of this vast body of terrestrial living matter, the most remarkable, characteristic, and important feature indeed, is the singular mode in which it exists or lives, from moment to moment. Although of such vast bulk and weight when considered in the aggregate, it is never found in continuous bulk, but always exists as minute *modica*, or little measures, isolated one from another, scattered throughout and embedded in non-living matter. On an average, these minute *modica* of living matter or protoplasm are not much more than the three-thousandth of an inch in diameter, but occasionally reach the one two-hundredth and larger; and their true or typical form is manifestly spherical. From the center of these small spherules life is exhibited. In consistency, the living substance is semi-fluid; it is so nearly transparent as to be deemed colorless; and it does not give off odorous particles. As above remarked, it is ordinary matter, oxygen, hydrogen, nitrogen, carbon, etc., and the cause of its peculiar behavior, in the living condition, is in all probability the manner in which the particles are combined, and their arrangement and relations one with another.

More profoundly, when we seek to know why living matter always assumes the form of and exists always in the small spherical integers, termed "cells," we are brought to contemplate a new law of matter which apparently acts counter to gravitation, or, as is more likely, prevails upon an interior plane of matter within that on

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which gravitation acts. It is the sway and prevalence of gravitation over ordinary matter which causes the world of matter, as we see it, to appear lifeless and inert. But in protoplasm, pure and unalloyed, we behold a law of matter, find expression, subversive of gravity, prevalent over it and transfiguring ordinary matter to living matter in spite of gravity, so to speak. This may seem a bold statement. Life, indeed, has been held by many biologists to be a corelative of gravitation, a cognate and derivative mode of the universal energy of matter. Cognate, indeed, it no doubt is; derivative also in the loose sense of being aided and facilitated by it in all the larger forms of terrestrial life; for it is assuredly not the intention here to convey the idea that the ordinary functions of animals are carried on contrary to gravity or chemism. The writer ventures, however, to set forth the conception that within a normal "cell" of living matter there is an expression of energy not derived from gravitation, but superior to it; as if emanating from an inner seat of energy, as if acting upon matter at a different angle or *point d'appui*. Such an opinion by no means conflicts with the monistic conception of energy. It is meant merely to set forth that life is not the immediate derivative of gravitation, or chemism, which many physical philosophers have been inclined to consider it, but rather a static property of matter which antedates gravity, and, in the intimate composition of matter, outranks it.

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Indeed, the truer view of this great question is probably that life finds but an irregular, erratic expression in the superficies of the terrestrial globe, where gravity and the grosser modes of universal energy prevail as a rule. Yet the conception will be found to grow in the mind of the student of living matter, that this wonderful static property is a very universal property; in a word, that all matter is *sentient* at bottom; and that its apparent *insentience*, or lifelessness and inertia, as seen on the earth, is less a natural than an unnatural and fortuitous condition into which it has fallen from the peculiar recoils incident to planetary formation.

This view need not incline the student to entertain pantheistic conceptions of matter, or drift away to extreme opinions as to a universal mind inherent in nature: an ocean of omniscient intellect, from which our "souls" are stray driblets. On the contrary, the entire trend and drift of biological science are to the effect that the primary static property of matter is sentience only in the sense that the raw flax is damask, that the crude ore is a steel warship, and that in the great tracts of universal matter there is nothing more intelligent than the *elements of intelligence;* even as in "protoplasm" of lowly grade there is little save the capacity to feel. Be it remembered, too, that there is now, probably, no "protoplasm" existent on the earth's surface of such lowly grade, such archaic simplicity upon the scale of intelligence, as

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that which first stirred on the early shores of the azoic oceans.

As the student examines those wonderful little integers, the "cells," day by day, the inquiry constantly presents itself, Why does the living matter adopt this form? Why does it live in these little globules of uniform size? — for although the size of cells differs considerably relatively to each other in different tissues and situations, the difference is mainly within certain definite limits; and the general type and form are unmistakable and apparently unchangeable.

Why does protoplasm exist in such small measures of substance, each scarcely more than a pin's point? Why do its "cells" fail, since they are constantly growing, to attain larger size, an inch or more in diameter? Why do they not coalesce in the tissues into one sentient working mass? And why, on the contrary, do they constantly divide, when these small dimensions are reached, and become dormant, die even, rather than transgress them? These are inquiries which the student will find often recurring as he observes cell life. The idea conveyed from the totality of such questionings is one of a certain ever-present barrier to protoplasmic life, or a constantly restricting law which makes life on the earth possible only in this small form, or type. Some stress of terrestrial matter appears to confine life to this minute expression. This little cell is the only way in which life upwells

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from the profound depths of matter. For it is apparent that the cell is but the *form*, the tiny thread-like channel from a deep-lying stratum, through which some very esoteric or final property of matter flickers up.

So great confusion of thought has often been exhibited on this subject of cell consentience that it is important to set the matter in a clear light. In the cell-of-life we have presented the spectacle of a thousandth of a grain of matter — oxygen, hydrogen, nitrogen, sulphur, phosphorus — which has set itself to *live*, set up for itself as against the rest of the universe, stepped out from its former relationship and allegiance to other matter, and started a new little world of its own. For that is what a living cell really is: a minute portion of universal matter which has withdrawn from the rest and set up autonomy. The laws of matter no longer control this thousandth of a grain of matter as formerly.

In every animal and in every cell there is always matter, a large per cent. of its bulk, which is not living, and hence inert; but the really living portion of the cell carries itself in defiance of gravitation. True, it is borne on by the earth on its orbit and revolves with it; none the less it is able to direct chemical action for its own behoof and combine forces to overcome gravity when it wishes to climb hills or trees. In a word, it fights gravitation to do as it pleases, and succeeds. So long as it lives and is not crushed out, it is to a degree independent and self-directive.

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The present development of life on the earth began in the age which geologists term the Silurian; but the presence of graphite in the Laurentian, or "azoic" rocks renders it not incredible that there was a previous life development which terminated, or was followed by a period of high temperature.

But to return to what is known, keeping it separate from conjecture, we find that low forms of unicellular life were existing on the earth many millions of years ago. Geology affords the evidence of this, though the exact number of millions of years is still debatable. That is not material to our purpose, however; it was a very long time ago. Fire, water, and unicellular life have wrought together to make the earth's surface what we find it to-day. But geologists are agreed that there was an azoic, or lifeless age, followed by an epoch when protozoons — vegetable and animal cells of life, the monera, protamœbidæ, diatoms, algæ, myxopods, rhizopods, ciliata, flagellata, *et al.* — had appeared; unicellular creatures from one ten-thousandth to a hundredth of an inch in diameter.

For millions, perhaps hundreds of millions of years, certain of these protozoons were the sole inhabitants of the earth which was fit for no higher form of life; or, if fit, no higher form had developed. Nothing more graphically illustrates the wealth of time at Nature's disposal, or the fact that the course of nature cannot be judged by human

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standards. Metazoons, creatures of higher, more complex organization, were to appear on the earth; yet through all these millions of years no sign or semblance of them was visible. Were three million centuries of unicellular life necessary to prepare the earth's surface for metazoons? The question is idle. Every measure of our estimation of nature breaks down on extended application. We have no code of morals for nature and can have none, for nature is eternal, and man a being of yesterdays and to-morrows.

The point to make here pertains merely to the fact that for ages and epochs, to which all subsequent time is but as an hour to a day, a lowly unicellular life was all that the earth bore.

Observers from afar, if such there were, might well have concluded that there would be no further development; thus other planets appear to our terrestrial astronomers; the epoch of life, or of the higher life-forms, has not yet arrived, or has passed.

Then occurred a new departure in terrestrial life, an innovation, but when, how early, or how late in that first long epoch of unicellular life we do not know. Some time during those millions of the earth's unhistoric revolutions an innovation on unicellular life began. From accident of the environvent, or, perchance, from

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malformation, two or more cells began to live united together, and to act in unison — the earliest metazoon! Or, as some biologists conjecture, an unusually tough cell wall, or membrane, may have restricted the ordinary course of multiplication by fission. The offspring or increase of a certain protozoon may have been unable to separate from the parent cell, to lead an individual life apart, as formerly, and thus two or more protozoa may have come to live together, in sentient, protoplasmic contact as one life, and to act for a common interest.

It is not essential to our argument to show how metazoons began. The point made is, that they came into existence and, beyond doubt, originated from the unicellular life which antedated them. In some way two or more cells contrived to merge their hitherto separate lives in one. Their separate sentiences were pooled, so to speak, in one consentient life.

This was accomplished by means of close protoplasmic contact, when the two hitherto separate cell lives coalesced, like two drops of water on a window-pane. For it is possible for two cells to live as one and form a single life or self-conscious existence, if there is close protoplasmic connection between the two, that is to say, if they touch each other, or are joined together by one or more threads of the sentient living matter. When this occurs, the two cells may have one common life, or soul, in place of the two lives previous to the union. One common life may

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take the place of two; and yet the two cell substances do not become confluent or coalesce; they merely touch and remain separate seats, or fountains of sentience; it is the two sentiences only which unite; as when two springs which issue at points near together combine their waters in one rill. The two cell lives combine in one stream, but the cells themselves remain distinct, separate founts of life. The tremendous significance of this fact is little recognized or understood as yet. It subverts the present theological doctrine of the human soul. It demonstrates that the intellect of man, the human personality, is composite and dissoluble.

At the outset, however, certain hasty conclusions which have sometimes misled investigators should be avoided. The bodies of the higher animals are something more than confederations of unicellular life; that is to say, they have not come directly from a banding together of cells that once lived separately. The animal organism develops from a single cell in the egg. All the millions of cells in the various tissues issue forth, seriatim, from this one reproductive cell, which seems to contain representative particles, reproductive molecules, or "biophors," and "determinants," corresponding to every tissue cell of the parent organism. We have by no means sounded the depths of this latter problem, as yet. One conjecture is, that the entire animal organism, in corelation with its generative tissue, fructifies in a species of sub-unicellular

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life; a germ life as far below the tissue cell life in size and bulk as the cell is smaller than the whole animal organism. The cell would thus appear to extrude a species of minute offspring which are assembled, as a colony, in the ovum.

Animals are grand communities of cells and something more, the result of long organization and new methods of cell life. But this distinction does not essentially detract from the importance which attaches to the phenomenon disclosed to us when *two cells combine to live one life.* I have termed this a new departure, yet must not be understood to assert that it took place suddenly, as being the beginning or end of an epoch, or as indicating a "creative act," that mental lapse to which certain venerable savants are so prone.

Here, too, it will be well to enlarge the common conception of a "cell." We are apt to think of unicellular life as being very low and simple, far down toward the primary molecules and "atoms" of matter. Whereas the truth appears to be that the "cell" is a relatively huge and vastly complex organism; and that the unicellular life of the globe is an evolution of a most hoary antiquity; herewith also this other fact should be associated and kept in mind, namely, that in the bodies of metazoons, in plants and trees, the unicellular type of life, this ancient life of the Silurian ages, still persists. In fact, it will hardly be too much to say that the unicellular is the

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only real, distinct type of life which exists, or has ever existed on the earth's surface. Since all the metazoons are but more or less well-organized and well-perfected confraternities of cell life, where the individual lives of millions of cells are unified in a single, larger personality.

Many of the polyzoa are suggestive of the manner in which multicellular organisms started. In *paludicella* we find cells joined together, as joints or sections of the branches of a minute tree-like growth, attached to stones in streams. It is a tree in miniature; the cells grow forth, one beyond another, offspring above parent cell, but otherwise have little connection one with another. It is simply an arboriform colony, or *zoarium*. Other polyzoa, like *mucronella*, form mat-like disks on stones in water, the cells lying in contact merely.

In certain of the zoaria of polyzoa, however, a considerable degree of individualization is exhibited with division of labor among the cells. In *christatella mucedo* the cells not only adhere, but the whole colony crawls with considerable facility from one water weed to another. *Kinetoskias* is another zoarium where the colony has arrived at the point of differentiation of function. *Adeona* presents an equally interesting example of a simple colony of unicells on its way toward a many-celled organism.

Among the hydrozoa, *siphonophora* affords an example where a floating colony of unicells has taken definite form and organized its individual cells to work for the common

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good. In siphonophora, as, indeed, in hundreds of other instances, the beginnings of multicellular mind are apparent. That is to say, there is present not only the cell intelligence — that which pertains to all cells — but that larger intelligence which comes into existence from the consentience of the entire colony — the pooling of the separate cell sentiences in one larger intelligence.

This habit among protozoons of colonizing — however it originated — opened the way to metazoons. Often the colony grows up around one mother cell, whose offspring instead of dispersing remain loosely attached together. Of such agglomerations *anthrophysa vegetans* is a good instance.

In other instances the envelope, or cuticle, of the mother cell expands and enlarges, forming a sac which contains the entire colony for a considerable time, till the reproductive power of the parent cell is exhausted. Eventually the sac bursts and the group disperses. Many of the flagellates exhibit this phenomenon, the parent organism continuing to move about after becoming a colony instead of a single cell.

In *gonium pectorale*, a volvocine of stagnant fresh waters, a colony of sixteen offspring cells adhere laterally to each other, in the form of a minute, rectangular plaque of a light green color. *Pandorina*, on the other hand, gives birth to either sixteen or thirty-two offspring, which live for a time in a species of globular colony, inside a thin

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envelope, through which each cell thrusts out two flagella. While living as a colony, these sixteen or thirty-two cells act together, as if actuated by a common impulse, moving their flagella in unison to propel the colony. It changes direction, tacks suddenly, and otherwise affords evidence that all the cells are acting together as one. Either there is a sentient contact which serves to enable the sixteen separate cells to act as one, or else a temporary species of nervous system, consisting of filamentous processes thrust forth from cell to cell.

In the oft-cited instance of *volvox globator*, the colony is of more complicated structure and forms a large green ball, to the surface of which the individual cells adhere in great numbers, as many as twelve thousands to a ball having been counted. In this case they appear to touch each other and are each provided with two flagella which project through the membrane. Here each cell appears to be a free agent within its own envelope, but projects protoplasmic threads or filaments, like telephonic wires, into its neighbors, by means of which a network of consentient communication is established. At an internal signal all the thousands of flagella swing in harmony like oars, and the ball moves from point to point. It is clear that something analogous to a nervous system is here present, even though of an ephemeral nature, consisting of filaments which can be thrust out and withdrawn at will.

In the dioecian volvox the male colony remains apart

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from the female cellules, except at time of fecundation, when both colonies break up, scatter, and presently conjugate in pairs and groups.

Colonies of protozoons which come from a single parent cell present some analogy with a multicellular animal organism, which also develops from a single egg-cell. The way, however, from a colony of *protista* to the organism of a vertebrate animal is long and, in its ætiology, but little understood.

The first metazoons were clearly temporary makeshifts, owing to stress of accidental conditions. It is likely, indeed, that they had often occurred for millions of years, occurred thousands of times, but had died out, or progressed no further than the polyzoa we see at present time, owing to unvarying conditions, flood and drought, heat and cold. But at some time one or more of these unions of cells chanced to survive longer and took more permanent form, sufficient permanence to carry it on and set up a new mode of life by organization — that organization and differentiation of cell function which was to play so grand a part in the future.

Space and a desire to make the argument continuous prevent more extended enumeration of such primitive unions of unicellular life. But one has only to look abroad on the face of nature to see conclusive proof of the position here taken. In every tree, shrub, and plant, in every animal that walks, every bird and insect that flies, we

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behold an agglomerated organized mass, or congeries, of cells, each filling its place and doing its appropriate part in a cell commonwealth. There may be thousands of cells in the plant or insect, or there may be millions in the tree or the animal. The proof, we say, is on all sides. Tree, animal, insect, alike, are examples of this principle of *e pluribus unum*, for the common good of all.

We wish here merely to show the manner in which the metazoons started, and the significance of the act when two or more protozoons unite to live one life and become one larger self.

No claim is set up here, that we know at present, from what colonies or unions of primitive unicells the vertebrata were developed. Nature, indeed, appears to have performed many strange experiments in multicellular organisms, long-extended and horrible experiments, which go far to convince us that we must not deify or even personify nature For nature is elemental and impersonal. The unicells first organized in uncouth and savage forms,

> **"Dragons of the prime that tare each other in their slime."**

Dinosaur, megatherium, and mastodon roared and battled through ages that to man are incomprehensible.

> **"A monstrous eft was at one time lord and master of earth,**
> **For him the bright sun shone and his river billowing ran."**

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Man's hundred thousand years are but as a span to the era of vertebrate monsters and monstrosities, while earth's young unicells were making their first tremendous efforts at organization.

But when two or more cells unite to live together as one, each has first to surrender, either temporarily or permanently, its own self-conscious personality; and then as a merger of all these surrendered personalities there ensues a larger, grander self about a new axis of self-consciousness.

The most perfect example of this self-surrender and resultant, grand consentience is exhibited in the brain of man. Here temporarily during the day some sixty millions of "cells" extend filamentous processes and, all taking hold of hands, so to speak, surrender each its self-consciousness and autonomy to form the human intellect. From this grand surrender, and at the instant it is made, there flashes forth the consentient human personality, the "soul of man." It is done as if by electric contact. This intellect or "soul" is the union of these sixty millions of brain cell lives; they surrender self to live as one.

But in the brain this is but a temporary self-surrender. Owing probably to the severe vital draught which the consentience makes on the individual cell the human intellect cannot remain constant or continuous. There

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must be respite and recuperation for the constituent cells. Accordingly we find that after ten or fifteen hours the consentient strain is relieved; the union is disrupted. Sleep ensues. Suddenly, as suddenly as it began, the brain cells let go hands. The filaments are retracted. Contact is broken. Each cell resumes its individual life, becomes itself again, self-conscious, and attends to its own personal affairs — nutrition, elimination of waste products, rest, growth.

But the instant the cells resume self-life, the human intellect has ceased, as when electric contact is broken, unconsciousness supervenes.

Why, it may be asked, why and how did the first two or more protozoons come to unite their self-lives in one larger self? From what seems accident of the environment, on the *objective* side; and for greater comfort, ease, and safety, on the *subjective* side; or rather when accident, or "the law of chance," had initiated the innovation, the subjective comfort which resulted from it led to a voluntary and wilful continuance of the new mode of living.

For by thus uniting, a division of the hard labor of living was possible; the single cell was no longer compelled to face the world alone and perform all the various kinds of labor which the act of living necessitated. After combining, one cell could do one kind of work and confine itself to that, and another, another kind. One cell, or group of cells, could attend to locomotion, as in *volvox*,

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another to securing food, and still another to digestion and assimilation of the food.

Soon, indeed, one cell, or group of cells, in the union, took upon itself the office of spying out food, or sighting danger and notifying the motive group to move forward swiftly, or to beat a hasty retreat. This spy cell, or group of cells, soon assumed the leadership. In time, complete differentiation of labor-function was effected. The locomotive or muscle group not only performed no other kind of labor, but became unable to perform other. Its internal organization conformed to this want of the union. So of the group which seized, or digested food, and preeminently so of the spy cell group which erelong devoted itself exclusively to discernment, intelligent decisions and a general directorate and protectorate of the other groups.

This apparent development of metazoons from protozoons, of so great significance in the terrestrial scheme of life, was set forth by this author some years since a little more in detail.

"Very soon after creatures composed of many cells (metazoons) were developed from groups of unicellular life, the necessities of locomotion in the struggle for food led to the differentiation of certain tracts of cells as bone and muscle, and finally to the development of the entire apparatus for mechanical movements.

"Simultaneously, too, another peculiar species of differentiation began to be necessary, namely, a special tis-

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sue, whose office should be that of intercommunication between the different associated cells and tracts of cells which were thus assuming more and more diverse offices, and becoming somewhat different in character, one from another. It was thus and for this reason that a nervous system began to be needed and hence to develop; for the plastic, living substance has always shown a faculty of adapting itself to widely variant functions and modes of living.

"Certain cells began to take up the business of receiving sensory influences from outlying cells which were hard pressed or in want of food, and of transmitting such sensory influences to contiguous cells. In short, certain lines of internal cells began to take upon themselves the task of conveying the sensations of others from one tract of the cellular mass to another tract, and of interpreting the sensation received from one tract to the comprehension of the sentience of another tract, so that action, within its sphere of action, would ensue in the second tract. In addition to their own sentient economy, these lines of cells in the incipient nervous system took up the function of common carriers of *sense*, and also the office of interpreters of the sensory language of one order of cells — if I may borrow the figure — to the different language of another order.

"Thus, humbly, as we conclude from observation of low forms of life, did the nervous system, or tissue of in-

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telligence, begin to develop. Primarily there was but one or two simple thread-like lines of cells attempting the office of transmitting feeling, and succeeding indifferently at first; but as animals increased in size, the business of telegraphing sensation grew, and a net-work of lines was developed. Sensation was going both ways, and soon the necessity of a common center to which sensory influences could be brought, and thence distributed to their proper destination, was forced upon the nascent, sense-conveying cells, and a ganglion, or little brain, came into existence. The confusion, too, resulting from counter-currents of feeling soon led to the formation of double lines, one for transmitting sensation inward, the other for transmission outward; and thus the divisions of sensory and motor nerves were inaugurated to and from the little brain center, which presently assumed the function of deciding upon the merits of transmitted sensations, and responding to them by a message from its own sensibility.

"Nerve ganglia multiplied as animals increased in bulk and attempted larger movements; and in time, to avoid confusion and get the organic business done, one ganglion was obliged to take the lead and keep order among the other ganglia, to decide between them when they got at variance, and generally to take the office of head ganglion.

"Thus, in time, a larger and capitally important ganglion was raised up into prominence to perform the function of oyer and terminer, a cerebellum, and finally a

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cerebrum, — a mass of highly organized cells which have from long use and inherited development the capacity for intelligent perception and thought."

Without any attempt to present a consecutive line of examples to illustrate the progressive development of the cerebro-spinal system, the above outline indicates the principle upon which this group of cells has come forward to occupy its present grand prominence as exponents of intelligence.

In treating of the cells of the brain as individual, living creatures, it may be well to set forth more explicitly what their *status* of intelligence probably is, and explain how far they may be regarded as sentient. It is not claimed for any unicellular creature that it possesses rational powers to such extent as is evinced by an organized tract of cells like that of the human brain. For in the human brain we find a great number of cells of four or more varieties, devoted some to memory, some to reason or the comparison of experiences, some to vision, some to hearing, and some to the estimation of the odors and flavors; and it is the sentience and experience of them all which is combined in the human intellect. Yet from observations of unicellular life we find, as in the case of ciliates, that it is quite possible for a single cell, no larger than many of the brain cells, to possess not only sentience, but to acquire the data of memory, and to act from its previous experience. Many forms of unicellular life, indeed, behave

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rationally; nor is there reason to suppose that the cells of the brain are less capable of perception and of memory. In the brain, however, cells of different tracts are concerned with experiences of particular kinds, some recording the data of vision, others the data of hearing, and still others collating and comparing such data. It is probable that a cell of the tract or group in the area of vision, for example, is largely occupied with depiction of visual imagery, and becomes a kind of living, sentient specialist, or expert in colors and scenery.

None the less it is a sentient creature, with its own internal economy of nutrition and growth. In a word, it is a sentient self. It perceives, lives and acts from its own personal point of view, for its own behoof and welfare. This much is quite certain. It is a sentient creature and within its limited sphere has acquired a kind of wisdom of its own. More we cannot predicate of the individual cell. It is a pygmy of a limited degree of intelligence.

Nor does our argument claim that the protozoons first banded together from intelligent foresight as to the result of union. The beginnings of metazoic life were probably accidental *per se.* But the results of union and division of labor followed quite the same, and it is from these actual results that our conclusions are drawn. By union of their hitherto separate sentiences the cells evolved a higher kind of sentience, a *nous*, a soul, developed to a

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higher degree of intelligence, from the exercise of which each cell of the organic union was grandly benefited in the matter of food and protection, and is enabled to become a participator and beneficiary of mind.

It may be added that the later physiology portrays the connection and intercommunication of cells in metazoons as based on and maintained by currents of "ions," liberated and set in motion by the vital processes, and depicts life itself as arising from the reciprocal action of these biogenetic units of matter.

The passage from the unicellular to organized multicellular forms of life, from protozoa to metazoa, was primarily effected by simple combinations of cells and varying of their functions. It was thus that the animal organism originated. The question of importance next to be asked is, What was gained by it? Of what use was it? What advantage accrued from it to the cells themselves which, from the strict biological point of view, are not only the first, but the only type of life that has ever appeared on the earth; since all life, organic as well as unicellular, goes on by virtue and instrumentality of the "cell" mode.

What advantage therefore has accrued to the cell, and how far has it by this means advanced toward that natural salvation which is the goal of all life?

A survey of the whole field shows clearly that the single cell made a great personal gain by uniting its life

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with its fellows. This is apparent even in the primitive colony of ciliates, more evident still in volvox, and grandly demonstrated in the animal organism. The cell in the colony lived longer and more comfortably than when struggling for life, alone; and at the acme of organization, in the vertebrate organism, we find cells which have attained to what is, for a cell, immortality. In unorganized unicellular life, the average life-time of a cell may have been less than two days, not much longer. In organized metazoic life, we find the neurons of the cerebral cortex of an elephant, or a whale, for example, living two centuries. By combining with their fellows, these cells, or their descendants, have increased their span of life thirty thousand times!

In man these brain cells often survive for a century. Human beings, with life-times correspondingly prolonged, would live to the age of eighteen thousand years.

It is apparent, moreover, that these groups of brain cells would live longer (for they give little evidence of having exhausted their capacity for living on) but for the fact that they are dragged down to death by the fate of the organism, *i. e.*, the failure of coordination among the other tissue groups of cells.

This is profoundly interesting as showing what cell life, under favorable conditions, may accomplish in the way of a vast longevity, — from successful combinations, and organization generally. There appear to be cells of the

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brain *which would live on indefinitely were it not for accidents to other parts of the organism.*

Generally speaking, longevity is the proof of correct living. That cell, or union of cells, lives long that is well nourished and well protected. No animal organism is as yet perfect, even approximately so. All the groups of tissue cells have not been equally advantaged by organic union, but taken together a great gain has resulted, chiefly in the matter of food and protection. The brain and muscle cells of the animal organism, for example, have their food specially prepared for them along the intestinal tract and brought to them in the arterial conduits, and they are housed and shielded from the mordant action of oxygen and the attacks of hostile bacteria by the integument and bony walls.

All the physiological cells are alike benefited in that prime requisite, food; and this fact must be kept in view when the higher social organization of the metazoons is considered. Food specially prepared and refined by groups of cells which have made this office their business, has largely conduced to the longevity of the physiological cell and made brain possible. Without a specially prepared food the organic cell could not survive for a day. Improved food, protection from enemies and, subjectively, that greater guiding intelligence that comes from organic life are the factors which have so improved the cell (the protozoon developed to a neuron) that it lives for a

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century in man, and in the whale, the carp and the elephant for two centuries.

In plant life as we now view it, banding together has not been as advantageous for the saprophytic cell. We have trees two thousand years old; but so far as we at present understand the arboreal economy, the vegetable cellules are not long-lived. This would follow, *a priori*, from the far less perfect organization of plants, the more crude food supplied to the cells, imperfect protection and the apparently inferior sentience of the cells themselves. The contrast but emphasizes the deduction made for the physiological cell, namely, that it has attained its pre-eminence by perfecting the organic union of which it is a unit. And the inference has sometimes been drawn that could the metazoon as seen in the animal organism be given a more perfect development, the component cells would reach that acme of natural salvation for which they have striven for two millions of centuries and would become, in very truth, deathless cells-of-life.

There is no more wonderful and grandly instructive spectacle in nature than this widespread and long-extended effort of the globe's unicellular life to save and preserve itself from hardship, accident, "disease," and death. Nor has the effort been "instinctive" in any other sense than all sentience is instinctive. From the subjective side of life, the primitive unicells of the ancient earth began to live together for mutual comfort, aid, and pro-

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tection, and continued these unions till by division of labor and differentiation of function the simple colony developed into the vertebrate animal organism, with its thirty specialized genera of cells, all acting together for the common weal.

Man must still turn to the unicells for grand examples of social organization and progress by means of organization. Vastly and grandly more than is yet exhibited in human civilizations have the protozoons united and combined for mutual betterment. In this maple, towering in leafy beauty, we may find two billions of arboreal cells, organized, apportioned for diverse labors, trained to special work, devoted and artisaned to the production of fiber, bark, sugar, and chlorophyl, and all in an orderly sequence of effects and a consecration of each cell self to its appointed task, and with an apparent content and faith in the outcome, when each does his share, such as the human world has never yet seen nor understood.

In that horse dashing along the track we behold several billions of cells, each a living creature, an individual life, banded, united, and organized in such multicellular complexity that it is the glory of anatomy and histology even to have demonstrated and described it. And in the matter of locomotion — since speed is the criterion in the horse — we may behold this entire body of cells moving at a speed a million times greater than that at which it would be possible for these cells to move if living isolated

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and solitary, as did the ancestral protozoon on the beach of the Cambrian Ocean.

We should not here be understood as denying or leaving out of the account the influence which the metazoic mind exerts for longevity. It is by reason of this superior intelligence, obtained by banding the small wits of the cells together, that those better conditions were gained which make cell longevity possible. Nor yet would we appear to assert that the animal organism lives for the benefit, or at the behoof of the component cells. In the animal brain the cells live to themselves only during the eight or ten hours of sleep daily. During waking hours the lives of all these cells are consentient, having banded and blended together to form the self-conscious mind of the animal, which devotes its energies to supplying the animal wants. Without this consentient union for mentation, locomotion, and general muscular activity, the animal could not have developed. The component cells improved, each its individual condition, by forming a consentient partnership.

This point might readily be given fuller illustration, and a thousand examples of metazoic life cited in evidence of the principle, rationale, and intent of the passage from unicellular to multicellular life; but the idea has been conveyed; and this is enough for our present purpose. The genuineness of the deduction can hardly be controverted. By banding together and by organization, with division of

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labor for the common good of the union, the cell-of-life, as first seen in the protozóon, has come to live two centuries, instead of two days, with a legitimate inference that it is practically deathless under improved organic conditions. That is to say, there is nothing in the constitution of the cell, no biogenetic law, that prevents it from living indefinitely. Revolutionary as this deduction may appear to those who teach and believe that death is a final law of nature, the reverse of that doctrine can now be confidently maintained. It need scarcely be added that this conclusion is of the greatest significance, as affecting our beliefs concerning human life and the future of life on the earth.

And now after metazoons, what? After cell unions and cell organization in the animal organism, what next? After an organized development which has resulted in the advancement of the cell, the brain cell, to a high degree of intelligence and a grand longevity, what next in the line of its progress?

Bearing in mind that the cell is the original and, strictly speaking, the only type or mode of life which has thus far appeared on the earth, what means will be adopted to still further improve and better its lot? Will it of its own initiative inaugurate anything better or greater than the animal organism as we see it about the cerebro-spinal axis in vertebrates?

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The answer would seem to be no, as regards the individual cell, and yes, as regards the consentient union of cells as displayed in the brain and mind of animals and man. And if yes, what has already been accomplished in this larger corporate capacity? Union and organization are manifestly the order and method of all life on the earth. Since the cell banded in the metazoons and made a grand gain for itself in so doing, we might naturally look for unions of metazoons for mutual benefit and progress. But here, as against such actual unions by contact, the physical laws of the globe of matter on which we live interpose obstacles. We cannot have sixty millions of men, or monkeys, or elephants living in a ball, like *volvox*. Contact-union for mutual aid, defense, protection, comfort, and improved food is limited. If we attempted to unite or blend a nation of people as a metazoon, or even make it resemble one in the matter of consentience, as, for example, the eighty or more millions in the United States, or the forty millions of Great Britain, every person, or citizen, would need to be represented as almost wholly deprived of locomotion, and seated, as if at a desk or table, in one place, where food and the material for his work were brought to him in ducts and tubes. Still further, it would be necessary to conceive of them all as built in and encased by the substances which they manufacture. Further still, and most essential of all to the truth and pertinence of the simile, we should need to depict every

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citizen as connected with his neighbors and through them with every other citizen, by cables, bands, or cords of sentient living matter continuous with his own living substance. We must picture, too, the more prominent class of citizens as having thrust forth immensely long tentacles, forming nets of this same sentient matter, extending long distances from their bodies, and lying in close contact with similar tentacles belonging to hundreds of their fellows, in order that they may feel and literally *sense* all that they do or think.

If this condition of things existed throughout the nation, we should undoubtedly find the individual citizens living as one enormous National Person. In place of eighty millions of individual men and women, we should see them unified in a self-conscious national life. Such a nation would act and conduct itself among other nations as a Personal Being.

Upon a lower plane of inorganic relationship of particle to particle and ion to ion, in the atomic sense, it is possible that such a unified personality possesses the universe, answering to the indefinite conception of deity. Gravitation has been held to be the lowly organized personality of cosmos, expressing itself in natural phenomena. Von Hartmann, in his "Philosophy of the Unconscious," appears to have grasped some such conception, which, however, he immediately perverted to the exigencies of an immoral philosophy.

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Since meta-metazoons, as of vertabrates, are physical impossibilities, the advantages which come from union and organization have to be secured in a different way, by other methods of obtaining the necessary consentience.

In hymenoptera (insect metazoons) the bees and ants offer suggestive examples of social and economic unions. In the swarm and apiary we find that differentiation of function and division of labor have proceeded far, and taken their place in heredity; and in the case of the queen bee the social organization has operated to greatly prolong her life. Swarm life also serves to afford general protection from enemies, equalize the food supply, and defend the union against the rigors of climate.

In the termite ants we find not only all these advantages gained from swarm organization, but others that come from the war-like operations which organized union renders possible.

In bird life, crows, pigeons, geese, penguins, and many other species have attained advantages from rude organization; and in mammalian life there are many humble examples of flocking, herding and banding together for mutual benefit, to gain protection from enemies and to secure food. The wild horse, bison and caribou herd for protection; wolves pack to pull down larger animals for food; baboons, monkeys and savage humans band, tribe and horde for protection, better food and companionship.

The lower vertebrate orders and primitive man have

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thus set us examples, so to speak, pioneered the way and initiated that larger organization by virtue of which "civilization" has arisen. The early and wild mutations of men furnish complicated yet fairly clear studies of the development of the nation from the tribe and the clan. No different principle is involved than that seen to be operative in the flock and horde, and also in the ant-hill and hive. It is the "instinctive" sentient effort and push of the cell-of-life to obtain better conditions.

It is not the intention here to enter upon the political history of mankind, the rise of nations and empires, or the causes of their decline. Nor yet to trace the beginnings of commerce, or the rise of the arts and sciences; or recount the history of war and the constant world-wide struggle for freedom from oppression. It is all a part of that process of union and organization of humanity, to secure higher advantages. Something analogous to it has taken place among the tissue cells in the development of the animal organism: the natural clash of conflicting interests, the fight of self against self-surrender for the common good, that self-surrender which comes so hard, yet always redounds subsequently to the individual good and ennoblement.

For fifty thousand years the effort at human organization has ebbed and flowed, operating blindly, misled by a thousand false ideals and "revelations." Religion has fought against religion, cult against cult, and "god"

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against "god." For the true law of human progress was not yet perceived. The ideal of human confraternity was not yet recognized; that ideal which the convexed surface of the globe so strongly suggests, and which the greater history of cell life so convincingly teaches. For it is the inestimable privilege of our science to narrate the rise of the cell-of-life and demonstrate the method and law of its progress; to found natural salvation and uphold a new ideal; to confirm the doctrine of human brotherhood as taught by the Founder of the Christian religion and, incidentally, to show why that sublime doctrine has for nineteen centuries appealed so strongly to the human heart; because it is a law of terrestrial life and a necessity to further human progress.

The advisability of peace and good-will among men had been taught before the Christian era, and the advantages of harmonious action set forth by others; but the personage who appears in history as Joshua, or Jesus, was the first who profoundly *felt* and *lived* it, and gave his life for it. In his mind glowed that divine ideal of a "kingdom of God" arising from brotherly love and that mutual cooperation and union of all humanity which alone can insure salvation under nature. Biology endorses with a cordial reverence the tremendous efficacy of that ideal and shows it to be in line with the whole progress of life on the earth. Science now labors for the realization of that ideal. Every other doctrine of the Christian faith

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will fall, its eschatology fade away. That alone will remain; for it is, indeed, millions of years old; it has been operative for two millions of centuries. Thousands of years before our era, unhistoric Christs had announced it in horde and conclave and died for it; but Jesus put it in the form of a world-faith for this latter epoch; and his service of love must ever command our reverent affection. He identified himself with that universal law of life by virtue of which ion and primeval psychon surrender their self-lives to form the cell life, the cell the human intellect, and by virtue of which still the human life will hereafter live in the grander life of a deathless humanity. For the psychon is not self-lost in the cell, nor the cell in the organism, but from its self-surrender lives a better and longer life; and in the future grand sodality of human life the individuals will become immortal, even as the cell has prolonged its life in the brain. The vital unit is not lost in the union. What it gives of self to the organization returns to it again with compensations; and he who casts his life into the consentient human effort, takes it again, ennobled by self-sacrifice; it returns to him, christened and imbued by the larger life of which for a time it has formed a part. The brain cell could never have attained its present estate but for the greater personal life of the organism in which, for a part of the time, it blends itself.

For the point to be kept steadily in view is, that cell

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life, perfect enough not to die, but live on continuously, is a question and merely a question of excellent food, protection from injury and germinal renewal, and not that death is a final "law of nature," as a false eschatology has hitherto taught mankind.

If the science of biology teaches anything, it teaches this truth of the possible deathlessness of cell life on the earth; and this truth is to the last degree important and revolutionary. The doctrine that death is a final "law of nature" has been made the cornerstone of that other cardinal doctrine, namely, the "disembodied spirit" myth. With the refutation of the doctrine that death is a "law of nature" will fall this latter doctrine of disembodied souls. For it will no longer have a *raison d'être*. In its place will come that grander gospel that *life* is the "law of nature," not death, and the demonstration, long overshadowed by errors of theology, that the "kingdom of God" is a natural development of life on the earth.

Two millions of centuries have struggled forward in pain and travail to make the human brain capable of the human intellect. It is a priceless heritage, the great ancestral estate of humanity. It is not destined forever, nor much longer, to be lost in death; we shall carry it through to a greater destiny. The true scope and intent of life is now just dawning in the minds of men. We are waking, — after idle dreams,— waking to what we can do and be, waking to the great possibilities of science, wak-

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ing to live, instead of resigning ourselves to death and mythical promises of ghost life.

But how? How will this be accomplished? Granted that the cells of the human brain may live for a century, the entire human organism still dies and the cells perish with it. How will this fate be altered or averted?

The answer is plain. It is already outlined and indicated in the manner and the means by which the cell has prolonged its lifetime from a few days to a century. We have but to study the rise and progress of the physiological cell. Its life history is set before our eyes in the animal organism. By union, organization, differentiation of function and division of labor for the common weal, this long-perfected animal organism has been developed. But now, to carry its development forward and immortalize the component cells, an onward step in organization is necessary. The human individual must be made the unit of a greater system, even as the cell has been the unit of the animal body.

And this greater system of union, organization and division of labor has already been initiated, unconsciously, it may be said, on the part of mankind. For thousands of years human beings have been banding together to this very end, unconscious of the real purport of their effort! The personal ends which, individually, men have had in view, as the motive of their labor, eventuate in a greater

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achievement than they wot of. For it does not follow that the human intellect, composed of cell sentiences, can always comprehend the outcome of its acts. The intellect is not yet sufficiently consentient to perceive and understand the deeper instinct of the component cells. Instinct, of which we have heard so much, is the dimly perceived motive and will of the cells.

But, as has been said, an organization by consentient or "protoplasmic" contact, human being to human being, is impracticable under the laws of terrestrial matter and undesirable for ideal and economic reasons. We therefore resort to a better kind of union and organization — better because it affords greater individual liberty, based on intercommunication by the use of abstract signs and symbols, and also impress the more ethereal states or modes of matter into our service to accomplish intercourse; so that personal feeling and thought (which is the feeling of the brain-cells) can be freely communicated from individual to individual, as freely and intelligibly as if by contact of protoplasmic filaments. Protozoons, indeed, might never have united to form metazoons had they possessed anything like human facilities for intercommunication. They were dependent wholly on touch and feeling, and on this sentient basis the animal organism, which we inherit, grew up.

The extent to which this humanly developed system of intercommunication has progressed need not here be de-

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scribed. Language, commerce, education, the industries, arts, sciences, law, religion, medicine and the entire social order have come forth and grown up from it. Mails, transportation, telegraphy and telephones are adaptations and inventions to effect a larger intercourse. In fact, the means and facilities for communication are now ample. It is not lack of these which delays the progress of humanity. A most rapid advance is possible. The obstacle to progress is the *lack of the spirit of cooperation, lack of confidence and good-will, lack of understanding of the real situation.* Instead of this essential good-will there is suspicion, envy and hatred, which pave the way to violent acts, war and destruction of the hard-earned fruits of labor.

It is the same ancient dislike of self-sacrifice seen in the protozoon, which so long delayed metazoic life; the same unbelief that the merging of self in the community will redound to the benefit of the individual; the same reluctance to work for the common weal; the same self-love that makes so many millions of our fellows unwilling to share and share alike with others, blinded to the fact that their greater happiness lies in just that act of self-surrender! Blind, too, to that other greater fact, *that along this line of self-sacrifice and cooperation alone lies salvation from disease and death. This is the Way.*

Just as the cells unite their lives and work together for the common good, so must the citizens of a nation or

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country devise methods and form habits of united effort, to accomplish great ends. The first step to this is good-fellowship, good will one to another, mutual confidence, and a determination to cooperate. There is no other way. Selfishness is retrogression. The way to enduring life is through consecration of self to the common good. This is the lesson from the cells. This is the method of nature. By following this method, for example, multicellular man may live eighteen thousand years. He may live forever.

In unicellular life, no separate single cell, by any device, or husbandry of its life, could have lived a century, or a year. It is only by union and self-consecration that the long-lived organism has been developed and the neuron become a partaker in its longer life. And even so in organized, perfected humanity the component individuals will become macro-biotic.

By united effort all are raised up to a higher plane of life. Faulty and imperfect as it is, human civilization has doubled the years of man. Twelve centuries ago the average length of a human life in Europe was evidently less than eighteen years. But compared with what science could do with its present resources of knowledge, existent civilization is but the most rudimentary of organizations. The effort at an advanced civilization is barely inaugurated, as yet. All the great results are to come.

The only obstacle is ignorance: ignorant distrust, ignorant hatreds for creed's sake, or for race's sake; fatuous

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ideals of patriotism, forgetting that all men are brothers; insensate ambitions to build up one nation in wealth and political power at the expense of the rest of the world, reckless of the refluent wave that will sweep it away in blood and loss.

The priests and preachers of Christianity have made but a feeble progress in convincing the world of the truth and utility of this great doctrine of Jesus, because they have not comprehended it themselves. They have understood neither its scope nor significance. The great doctrine of brotherly love and human equality has been preached rather as a sentimental tenet, a species of Sabbath-day duty, a symbol of allegiance to the church, a kind of holy discipline for the soul, to prepare it for "another world." They have missed, lost and sacrificed the power of the golden rule as an agent for controlling and elevating mankind, because they have made it a shibboleth of church membership rather than a prime requisite of human progress. The real significance of this doctrine has yet to be made plain to human eyes; its real strength has yet to be manifested. Then, not till then, will the human race accept it and act on it. This deeper-lying truth of life has yet to be instilled in the mind of humanity. Church Christianity has never evinced an understanding of it, perhaps never can have an adequate comprehension of it, as long as the "kingdom of God" is believed to be an immaterial realm of disembodied spirits

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in some unknown quarter of the universe. The Son of David distinctly and repeatedly claimed to be the Hebrew Messiah, the realization of the prophet-promise of Jehovah to the patriarchs. He is a rash commentator who asserts that the Beni-Israel ever believed this promised Messiah to be other than a terrestrial one, the founder of a kingdom of God and of Israel on the earth. There has been a fatal break in the facts of Scripture here, an insincere compromise with Zend-Avestan spirit myths, which has always weakened Christianity as a world faith, and from which science will now shortly compel it to purge itself or fall.

The golden rule is no sentimental phantasy of an exalted dreamer, but a matter of human utility and necessity. This is the Way, and until it is adopted, nationally and internationally, mankind will stick and pause in its onward career. It is a prime requisite to the farther progress of human life, and as such must be recognized by civilized man everywhere. It is that greater Christianity which is yet to come.

The difficulty of initiating an era of good-will and mutual cooperation lies not so much in the perversity of men, individually, or their inherent unwillingness to make those needful sacrifices, as in our present inability to bring about a world-wide understanding and to secure

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common consent of all parties and peoples. Thousands, yes, millions of the dominant race, are convinced that the highest good of all lies in an unselfish federation and organization of all terrestrial interests. But there are the alien races, speaking other tongues and intensely jealous of the dominant race; and even worse, there are the oppugnant religious systems, each claiming to hold all the truth in the universe, possessing each a supreme deity and sacred ritual of its own, and denouncing the votaries of all other systems as enemies of Good and emissaries of Evil.

Strangely enough — where the converse should hold — it is religion which will longest bar the coming of "the kingdom of God!" Sadly enough, too, it is not those tenets that pertain to life on the earth which have set sectaries so inveterately apart, but doctrines concerning future paradises and gehennas.

The saddest spectacle which the earth presents is that of the zealot millions ready to carry war and devastation, from continent to continent, in the name of Allah or Jehovah. If the biologist ever utters a prayer it is for human deliverance from religion in the fossil state. If one world-task looks harder than another, it is to redeem the human brain from the incubus of religious indoctrination, and set it natural again, capable once more of a normal perception of truth. Herakles of old might have blanched at that labor.

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For the brain is "formed" and the courses of thought molded to doctrinal ideas, taught by church authority. When these doctrines have been inculcated for centuries, and then found to be wrong, the task of rectification is a most disheartening one. Considered in gross, the entire brain of humanity, at present, is under the spell of erroneous creeds, and does its thinking along perverted channels of mentation. The belief that this earth is merely a place of probation for heaven after the death of the body is the worst possible initiative for the achievement of that natural salvation which is, and has ever been, the real goal of life. Mankind cannot rise in opposition to its own faith, nor will the effort to attain a natural salvation begin in earnest until the truth and the facts concerning the soul of man are understood and accepted.

The inference and argument for natural salvation have brought us, step by step, from the protozoon to that wonderful congeries and federation of cells, grouped about the cerebro-spinal axis of man; in other words, to man in his present imperfect social organization; his blindly selfish attitude to his fellow-beings; his weapons and engines of destruction; his standing armies and navies; his wars and his antagonistic creeds. That confident cooperation and good-will to his fellows, necessary to organize humanity for its crowning achievement — the achieve-

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ment of immortal life — have yet to be inspired in the hearts of men; and the point to be kept in view is, that this is the inspiration imperatively necessary to future progress, the sine qua non of the human situation.

No gift of prophecy, no skill of divination, is required to forecast what might be done on our planet in half a century of good-will and cordial cooperation among men. When the billions of hard-earned wealth, now wasted in war and warlike equipment, are applied to research, discovery, invention and the general application of knowledge to the amelioration of human life, then will begin an era of human advancement to which all previous progress is as a fitful starbeam to the glory of the rising sun! Dull is the mental vision of him who cannot discern this promise of our incipient sciences. It will surely come; but it might come speedily, before the year 2000. It will come from the combining of all human knowledge, the joining of brain to brain by mutual incentive, like cells of an electric battery joined to raise strength of current, to secure that consentient elevation of intelligence which will carry achievement to an ecstasy of enthusiasm and great hope.

There is inventive talent enough in the general brain of mankind, now lying inactive, unemployed, or perverted, to obviate most of human ills, could this talent and genius be given opportunity and incentive, and be organized for work.

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Fifty years of such organized effort would usher in achievements even to predict which would now be thought visionary. Fifty years of confraternal endeavor would so perfect locomotion and transportation that journeying to any portion of the globe could be accomplished in from three to five days, accomplished in ease and comfort, and with a fair degree of safety.

This of itself would be the first and best step to effacing the ancient antipathies of race and religion. The formula for introducing the Golden Rule among men is intercommunication versus ancient isolation.

Within fifty years, perhaps much less, we might come to understand the internal economy of the cell-of-life, and might master the problems of its reproduction. These problems are already outlined; but we are still ignorant why the somatic cells wax and wane, from youth to age; or more explicitly, what charge of ions, "biophors," or "gemmules" is concentrated in the cells of the germplasm; how this marvelous recharging of life from generation to generation is accomplished; why the commingling of cells from the two sexes is advantageous, or requisite; and, in general, the nature, chemical composition and mode of production of these minute germ elements of the organic tissues.

These are studies and discoveries which urgently wait the scrutiny of earnest, well-equipped students of our science. That they are beyond human discovery might have

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been believed once, but will hardly obtain credit in our times. In fact, we are on the brink of such discoveries.

We need to know the composition of the animal ovum, of what the germinal matter consists, how and whence it arrives there, and how it may be produced artificially. We have to discover what selected components — ions, electrons, psychons, or biophors — this animal ovum is composed, to the end that the various tracts of somatic cells issue from it and coordinate in the tissues of the organism. We have to learn on what actual physical basis old-aging proceeds: whether as animal life goes on, the tissue cell is slowly depleted of its initial complement of germinal matter; whether the original "charge" of ancestral life-germs is gradually exhausted in numbers or potency; or whether the contents of this body cell are homogeneous, and old-aging ensues from imperfect foods and the ravages and deleterious products of bacteria.

In short, we have to learn whether the somatic cell runs down, like a water spring, from expenditure of its concentrated biophors, or whether it is simply smothered, poisoned, slowly encysted and suffocated by the weathering, infiltration, and induration of the tissues in which it lies embedded. Whether old-aging is a slow form of starvation from the contraction and hardening of the capillary walls and the thickening of the lung membranes.

Or yet, whether all these causes operate together.

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namely, slow starvation and suffocation, combined with depletion of the inherited germinal matter.

For exhaustion or expenditure of the vivific units of the somatic cells, some process of inoculation, kataphoresis, or inward radiation of ions may be devised; for the progressive suffocation, poisoning-out and starvation of the cells, an amelioration of all the conditions of life as we now live it, must be accomplished, viz., the extermination of bacteria, purification of the atmosphere and the use of foods adapted to protoplasmic renewal; all purely physical problems and properly the subjects of scientific research; and all in line and continuation of that natural salvation of the cell-of-life from accident, disease and death, which has been in progress since life began on the earth.

Parent and child, through a hundred generations, constitute but one human personality, pressing forward, in time, to become something better, wiser, more powerful and happier. The parent dies and the child succeeds, but at a vast loss of knowledge and of time, not because death and birth are the ideal or ultimate laws of life, but merely because we have not yet acquired sufficient knowledge and power to escape death. The human personality, incarnate, living on from century to century, conserving science, able to renew itself and resist all the vulgar agencies of decay and death, is the ideal human being, not a chain of parents and children.

But life, as we now live, is one long contention with

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accidents, bacteria, improper food, duress of climate and hostile fellow-creatures. First the cell was driven to a mode of reproduction, to escape extinction; multicellular creatures developed from cells and may be said to have inherited the reproductive mode of life. Humanity has arisen from its lower ancestry to its present estate, by virtue of the reproductive, alternate mode of life. Hence, to die appears to many persons to be as natural a fate as to be born; yet when more closely examined, death is seen to be an unnatural event, a result of hardship and distress, a fate repugnant to life everywhere and a catastrophe to be escaped.

The Weismann hypothesis of life, death and heredity is so well known and so generally accepted, in part, among English and American biologists, that an extended statement of it is unnecessary here. It has taken its place in our science; and the two important modifications to which it must be subjected are now fairly well outlined. Professor Weismann has been termed the Darwin of cell development; to the present writer it seems that he might better be called the Lamarck, and that the Darwin of the animal cell has yet to appear.

Weismann's positions are (1) that death is not an inherent necessity of unicellular life. The unicells do not die, but divide, giving rise to offspring by fission. "No

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amœba has ever lost an ancestor by death." Weismann defines death as "a definite arrest of life. The proof of death is that the organized substance which previously gave rise to the phenomena of life forever ceases to originate such phenomena." Death implies the presence of something dead. An amœba, for example, produces offspring by dividing into two amœbæ. By this act of fission the parent disappears in the two children, but has not died. Hence arises Weismann's conception of the natural immortality of the protozoons. The protozoons die only from accidents of heat, cold, or violence. This view, however, has now of necessity to be modified.

(2) These deductions apply not only to protozoons, but essentially to all living creatures which produce offspring by fission; and it is on this basis that Weismann has built up his theory of the origin of death, briefly this: Since amœbæ and other unicells which reproduce by fission are naturally immortal, death must be regarded as peculiar to multicellular organisms (metazoa). In the metazoa where the cells are organized with differentiation of function, there are two distinct classes or groups, those which develop to form the animal body (soma), and the reproductive cells, confined to the generative tract. The former (somatic cells) grow till the organic limits are reached, live for a time and fall into senescence; the latter (the reproductive cells) are the units from which the next generation will be developed. The somatic cells are

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concerned only with the life and welfare of the individual, the reproductive cells with the continuance of the species. Of the two classes of cells the reproductive live on from generation to generation, never die in fact; the somatic cells alone are subject to death. The reproductive cells are immortal, as the amœba is immortal; they die only by the — to them — accident of the death of the body.

(3) It is an error to regard the animal or human organism (soma) as the essential or important part. The reproductive tissue (germ-plasm) alone is of importance. The *soma* is subordinate and exists for the purpose of carrying forward the germ-plasm. It is its vehicle of life, exists for no other object, and has no other *raison d'être*. In the opinion of Professor Weismann, the human brain exists solely for the purpose of nourishing, protecting, and bearing forward the group of cells lodged in the organs of generation.

(4) He further holds that the origin of death is found in the consideration, that it is advantageous to the species that the individual animals, or humans, shall die. "If for a moment we imagine that one of the higher animals were to become immortal, it is perfectly obvious that it would cease to be of value to the species to which it belongs. On one hand, there is the necessity of reproduction, on the other, the utility of death." He argues that the duration of individual life is, in all cases, that which is best for the species. For example, the May-fly lives but a few

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hours, because no more time is needed for depositing her eggs. With mammals, on the other hand, years are required for the rearing of offspring sufficient to make good their places in nature.

(5) With regard to the proximate causes of death, Weismann holds it to be due to the somatic cells losing the power of growth and multiplication after a certain length of time, or a certain number of cell generations. "Length of life in the individual is dependent upon the number of generations of somatic cells, which are able to succeed each other from the original endowment in the ovum."

(6) As regards heredity and inheritance, Professor Weismann discredits the common opinion that the personal lives, habits and efforts of parents affect the character of their offspring. His theory of a distinct germ-plasm controverts the concept of Darwin that "gemmules" from all the somatic cells are garnered up in the reproductive cells, and thus reduplicate the parents in their offspring. Nothing of this, from the soma, is conveyed to the germ-plasm, or affects, save in extreme contingencies, the reproductive cells.

Like Herbert Spencer, Weismann conceives that life on its lowest plane, unmodified by environment and unorganized, exists through or by virtue of "physiological units," which he, however, terms *biophors* (life-bearers), a conception not unlike that of the *plasomes* of Brücke, or the *plastidules* of Haeckel. In the lowest forms of

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life, the biophors are little organized; but, under the influence of the environment, as evolution proceeded, the biophors assumed certain persistent relationships to each other and formed themselves in fixed groups. Such groups determined the character of the cell, and to these Professor Weismann has given the name of cell-determinants.

Numbers of determinants are associated in larger groups, termed *ids*, and ids again as *idants:* relationships of biophors which form parts of the centrosome and chromosome of the cell.

(7) It is Professor Weismann's conception that death — touching its origin — is intimately connected with sexual reproduction.

That the protozoons are naturally immortal and that death is confined to the metazoons has been refuted since Professor Weismann put forth his hypothesis in 1881. Maupas has shown that certain protozoons exhibit the phenomena of senescence and die out from intracellular causes; also that protozoons conjugate sexually and are thereby restored. The hardship of the terrestrial habitat affects even the lowest, simplest forms of life, perhaps even the "biophors" themselves. The latest advances in physics indicate that "atoms" tend to waste away, and future researches may prove that the ions and electrons are not stable units. Avoiding death is less a question of ultimate, incorruptible atoms than of making scientific repair excel natural waste.

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That many groups of the somatic cells tend to senescence and exhaustion, in time, is apparently true, but this tendency should not be looked upon from the standpoint of the fatalist. Beyond doubt it is a tendency and a condition which can be remedied. The science which discovers the condition, will erelong discover the remedy. The brain group of cells tends least to senescence.

It is but natural that having brought forward his hypothesis of the germ-plasm, Professor Weismann should attribute a leading rôle to this group of cells and give it marked prominence. This is seen in his unqualified assertion that the individual exists solely for the purpose of bearing forward the germ-plasm from generation to generation. This deduction is true in a sense, but hardly in that sense of finality which Professor Weismann is inclined to ascribe. Beyond doubt it is difficult to say why life exists at all. The purposes and intents of creation are not as clear to the biologist as to the theologian. Professor Weismann holds that the individual animal, or human, lives as long as is necessary to bring forth and foster offspring, no longer, then dies because its death is necessary for the good of the species, or, strictly speaking, the good of the germ-plasm. If this assertion, with its incident fatalism, were restricted to evolution in the past and cast no black shadow on the future of evolution, it would be more rational, less repugnant to the bond "individual," who is made to play the rôle of a hopeless

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serf of death. We cannot resist the conviction that ultimately, at least, the germ-plasm exists or will exist for the good of the individual, not the individual for the germ-plasm; that the brain group of cells is of greater consequence than the generative group. But again we admit that it is rash to say that anything exists for any purpose whatever. Purpose, conscious purpose, does not come in until there is brain. There is apparently no purpose in lower nature, or if a purpose it appears to be an unconscious one.

According to the Weismann hypothesis, the reproductive cells give rise to offspring by virtue of the permutations and combinations of their own constituent biophors; the somatic cells do not contribute to the germ-plasm either from their substance, nor otherwise. The soma, indeed, grows from germinal matter in the reproductive cells, but exerts little or no influence upon that tract. The germ-plasm lives apart and to itself, and is sufficient in itself for all which we know as heredity, unaffected by the life or culture of the soma.

But when we consider the intimate relation in which the reproductive organs stand to the whole organism, when we contemplate the close nervous connection and sentient sympathy between this group of cells and the brain, when we consider the constant streams of electrons which are poured to these cells from the brain and other organs of the soma, when we picture the steady circulation

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or ions from the brain cells through these cells — it seems well-nigh marvelous that this group (the germ-plasm) should be so little affected, so little modified as Professor Weismann would have us believe.

Later researches afford indications that the intimate causes of old-aging are resident, primarily, in the cell nucleus. It has even been held by one observer that the cell nucleus lives, individual and apart from its cell host, originally intrusive and parasitic. But if so, it has become so well domesticated as to participate naturally in the life of the cell.

The nucleus is found to be made up of a series of granules, composed of a substance chemically rich in phosphorus, to which the name of *nuclein* is given. These granules take aniline stains very readily, and are thus seen to be connected one to another by the substance *linine*, which is not colored by the same dyes. Thus examined in old and young cells, the quantity of nuclein in the latter is found to be so uniformly greater in many instances that the deduction is made that there is a progressive diminution of nuclein granules from youth to age, as the nucleus divides, giving birth to new generations. As the nuclear granules diminish, the somatic cell falls into senescence, sinking to a condition where fission ceases. For a long time it rallies and divides again, but produces an enfeebled

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offspring, till finally it encysts itself and forever ceases to be parturient. The present theory is that no new nuclear granules are engendered in the somatic cell. Like the worker-bee in the apiary, it is differentiated and specialized beyond the power to produce offspring. In like manner isolated ciliates lose the power of reproduction, unless opportunity is given them for conjugation with other individuals.

Brown-Sequard conceived the idea of reaching and restoring the somatic cell by injecting triturations of reproductive glands, as medicines; and beyond doubt methods of restoration by inoculation, or vivific foods, will be discovered.

The rapidity with which the remotest tracts of cells in the organism are influenced and permanently affected by the introduction of minute quantities of remedial substances into the blood-circulatory is now well known to the medical profession. Such inoculation affords more direct access to the cellular seats of life than the alimentary tract with its modifying acids. The blood is in immediate relations and actual close contact with the cells which, in all cases, must be reached before remedial effects are produced. Nothing acts in the animal organism until the cell is reached and its sentient economy affected. Many eminent physicians are, therefore, of the opinion that injection into the circulation offers the best method of administering certain medicines.

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Inoculation to produce immunity from diphtheria, smallpox, hydrophobia, *et al.*, has been successfully practised for many years, as also by veterinaries as tests for tuberculosis. The procedure is in its infancy, as yet, but is one of great promise, since it is the cell which must be acted upon, and the rapidly propelled blood, reaching it almost instantly, comes in touch with its sentient surfaces. As soon, therefore, as we can discover and compose regenerating substances, or those which will stimulate regeneration, the blood-circulatory affords an efficient route to every cell in the body.

What these substances are, we do not yet know, whether artificially propagated nuclein, or reagents which stimulate its growth *in situ*. But if anatomy and histology offer us one hint more significantly than another, it is that the blood may be made a breeding-ground for the regeneration of the somatic cell. Five thousand well-equipped investigators, starting off with enthusiasm and rivalry to study this problem, would hardly fail in twenty years to set us far on the way to the control of all life. What our rich men spend yearly in their vacuous craze for horse-racing alone would more than equip and maintain these researches. Such inane squander and misdirection of the world's hard-earned money cries down Heaven's condemnation. But they know not what they do! Misled and bewildered by erroneous creeds and futile ideals, they know not how otherwise to

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spend the millions which they even believe belong to them.

A hopeless phase of thought has come to many biologists from regarding the ordinary course of nature as final for the human race. Whereas, nothing is more probable than that we shall come to direct and control the processes of nature in the cell. What takes place in the nucleus and the causes of nuclear exhaustion will yet be found a very simple chemical problem. The control of life in matter is unquestionably before us; the entire progress and trend of research look to such achievements. But for this outlook of hope, we might well accept the dictum of Bichat, that "from infancy we die, day by day." The cells of the *soma* develop in a certain way and to a certain end; nor is there the least likelihood that the human organism of its present physiological bent would ever reach great length of life.

We mean that the somatic cells, unaided by the human intellect, would continue to produce an organism, subject to growth and decline. The ancestry and nuclear endowment of the cell carry it to a termination of its activities. This is more apparent in the dark-skinned races of mankind than in the dominant race, and still more evident in the lower animal orders.

Lower unassisted nature would live and die in alternate generations as long as the earth offered a foothold for life. The chemical affinities and electric tension of terrestrial

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matter foster this method of vital expression. There would be little hope of anything much better or longer-lived. The earth is not, in its present condition, a habitat for deathless life. Its inclemency, its extremes of heat and cold, furious winds, hours of darkness, variant electrical condition and, more inimical still, its hordes of hostile bacteria, — all are against enduring life-forms. We see, therefore, that in a manner the primary instinct of the early races of man is right; this earth, unregenerate, is not the place for immortal life. Some improved condition is to be sought for that, some promised land, some realm of godhood. Not till this century has the vision of all these human ages begun to be interpreted. Alchemists had dreamed of a sporadic immortality by magic potations; but not till now have men come to see that vastly prolonged life is to be the outcome of brain evolution.

We look up to the disk of the earth's older sister planet and see its surface spangled with a strangely familiar geometry: parallel "canals," or belts of vegetation, and at the intersection of these canals "oases" which may be the Martian realization of "heaven," from which the germs of disease have been excluded. What interplanetary rivalry in good works do those "oases" suggest! Will our earth ever turn its face to the gaze of the universe, seamed by such giant engineering?

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When we ask the question broadly — Why does the human body grow old and at length cease from function?— putting the inquiry in the bio-physical sense, the answer seems to be that the personal life embodied in the organism is at length overcome and overmatched by the totality of the resistance to life which it encounters, from the embryonic stage onward; more specifically, to the general telluric resistance, physical, chemical, molar, molecular, which the protoplasmic molecules of the organism meet with, as long as they maintain the personal life. After adult age is reached, they lose ground in the struggle and at last succumb. The downward curve of the somatic cell has begun. But there is a period, during adolescence, when the cells gain ground, when they make head against the terrestrial resistance to life and prevail joyously, with a sense of victory; when the inherent energy of the personal life is more than sufficient to breast the opposition.

We have, therefore, to picture this personal life of the cell as an impulse which for a time rises superior to the resistance, then slackens and falls away to cessation

Yet its source in matter is apparently a constant in nature, inseparable from the material ion, and persistent in matter at a uniform tension. Why then, in the human organism, is it exhibited thus intermittently, as "wave motion"; in adolescence and senescence; in youth and old age?

The answer is that human life, even as waves on the

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ocean, or sound waves in the air, has fallen into the rhythmic, wave mode of life, as a general result of the terrestrial resistance to life; and that the cessation of vital energy, seen in aging organisms, is apparent rather than real, marking a transfer of life from one generation to another.

The transfer of life by means of the reproductive elements, and the subsequent death of the parent organism, is a mode of life into which all animal orders fell far back among the earliest metazoons, if not in unicellular life itself.

It is manifest, too, that this tendency or life habit of humanity is very deeply rooted in the cellular elements of our being. The cell determinants are cast for growth and decline. Sterilization of the reproductive tissue in the individual, removal of these tissues, or the most rigidly enforced continence have little or no effect as regards the aging and death of the organism. The tendency of the body to follow its inherited cycle of growth and decline is inveterate, and not to be changed by the exercise of the will. Something, indeed, this will-power of the personal life may effect, but not that radical transformation of being which the perpetuation of the individual implies. It is to our science that we must look for prolonged life.

Procreative desire rapidly slackens in individuals to whom life offers sufficient attractions to live on for life's higher, more refined pleasures; and in this circumstance

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we have a certain earnest of evidence that the higher intellectual life of the future will physiologically redound to a prolongation of individual life. Decline of the procreative instinct follows naturally when the individual has hopes of surviving; and such decline and self-continence react to prolong life; yet centuries would scarcely suffice to alter the deep-seated trend and course of our ancestry. It is to our sciences — the superior intelligence of brain — that we look for aid in prolonging our lives. Man has already passed the point where he relies for his progress on the tedious course of terrestrial nature unassisted. He reaches forth a Promethean arm and, in the light of his stores of knowledge, bends lower nature to his wishes. We expect to bring our sciences to act upon the cellular basis of our lives and accomplish its regeneration.

Under low nature, man would never surpass the purely animal cycle of organic growth and decline; of adolescence, maturity, and old age. It is only by rising superior to the lower course of nature that man has become something more than an animal order of life, recording experience in written language, kindling fire, smelting the metals, impressing the lower animal orders into his service, and even dominating the forces of nature, in order to travel by steam and speak around the globe by electricity. He has put lower nature in harness and now directs natural law.

In view of these grand victories, why should he despair

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of altering the lower course of nature in his organism and of directing the life of the cells of which his tissues are composed? The question is a novel one, in this sense. Hitherto, biologists have assured us that we must be content to be what inheritance would make us. That is the old cell doctrine in a nutshell. Weismann and, in general, the German, English and many American histologists base their theories of life on this assumption, namely, that the ordinary course of nature must be final as to man's future. Nature is fate.

But brain is higher nature, the acme, at present, of natural development. Everything which makes man a civilized and enlightened being has been obtained by brain mastery of lower nature and the diversion of her ordinary courses to his advantage. Why should we not expect to thus arbitrarily change and facilitate the nutrition and life of the cell? In point of fact, that is what has been done and is being done constantly in a hundred ways already. The position of not a few biologists on this question to-day is much as those who would argue that since a man can walk but fifty miles in a day, afoot, by his natural means of locomotion, or swim but twenty miles, he can never go to San Francisco in less than sixty days, or reach Liverpool in less than five months. Three hundred miles per day are as natural to brain as twenty miles to muscle.

It is to science that we look for the control of cell life.

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Biological science, it is true, is still in its infancy, but it is a very hopeful infancy; and it is the opinion of many of its best exponents that within another quarter of a century we shall have penetrated the secret of cell nutrition and growth, and opened the way to a scientific renovation of the tissues.

But faith has to be engendered as well as discoveries made. Enlightened man, indeed, is but just awakening to the idea that he may possibly escape death by setting his wits to work to this end; and, as ever, there is the olden outcry of impiety raised against the conception, as if it were wrong to try to live! As if it were not natural to live on!

But greatly prolonged life implies an amelioration of all the conditions of the terrestrial habitat, and within fifty years well-nigh complete control of the aerial currents and rainfall might be attained, if only a modicum of the intellect of the race could be concentrated upon these problems. This achievement will go far to bring about that physical paradisation of the earth, needful to redeem it from the imputation which it has so long endured, of being "a dreary bourne" and a place of exile to homesick souls who long to flee away to some better land. The earth will yet be made one of "the garden spots" of the universe. It is a purely physical problem, and not a little of the data for its solution is already in our hands. Foretelling the weather is the first step to controlling the

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weather. It is a question of the electrical distribution and regulation of the solar heat which falls on the earth's surface, and the direction of the "trade" or retro-rotary winds due to rarefaction and the earth's axial motion.

The electrical distribution of the earth's share of the sun's radiation will make it possible, not only to regulate the rainfall, but gage vaporization from the ocean and lakes. Droughts and freshets, tornadoes and frosts, might soon become disasters of a past age, if the resources of control which are already coming within our grasp can be applied. What is expended in national preparation for war, in a single year, would suffice to initiate the preliminary plants and stations for experimentation in heat distribution.

Climate is as much a terrestrial condition to be controlled as a city's water-supply. A bad climate will be quite unnecessary in the year 2000. The problem of irrigation is properly one of a regulated rainfall rather than of dams, canals, or artesian wells. Vaporization and rainfall are the factors to be controlled. An equable distribution of solar heat and a regulated electrical tension are the agencies to be used to this end. The whole problem of climate-control is already outlined in physics, as to its methods. We need but the wasted war appropriations and the labor of idle soldiers to put it in operation.

Such a half century of rational cooperation would see even more revolutionary advances in our methods of

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communication, now effected by mails, telegraphs, and telephones. Not only will messages and general news be transmitted, electrically, but be accompanied by photographic and phonographic representation of passing events. But of far greater significance to life, its prolongation and improvement, will be the conquest and extirpation of those teeming hordes of bacteria which infest the animal organism and render all organic life abnormal and precarious. Human life in the future is to be liberated not only from known "germs of disease," but those swarms of less deadly, but yet deleterious micro-organisms of which the human body is the host and which, by their presence and products, enfeeble life and maintain diseased conditions. The human body must be regarded not only as living amidst and externally exposed to microscopic life of a hostile and noxious character, but as being infested by such life which entering the blood-circulatory either with food, water, or air, penetrate to every tissue and organ.

Ninety per cent. of all human casualties are either directly from the presence of micro-organisms, or induced by the more or less remote effects of their activity. The extirpation of bacteria will be a long step toward the achievement of vastly prolonged life. Like all the others, it is a purely physical problem and only waits combined action on a great scale on the part of mankind. The habitat of man has to be purged and cleansed from these

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now well-known causes of death. The task is too great to be undertaken by individuals, and remains over for the organized effort of nations and races.

All life which is really living and worth living is progress; and an interesting feature of the next fifty years will be presented by improved human habitations. A new type of dwelling has already appeared in the larger communities — a communal house — admirable in its sanitary arrangements, ventilation, heating and lighting, with a common kitchen, relieving the individual heads of families from the costly and unnecessary drudgery of so many small, isolated cooking-places. The lofty steel and brick city apartment house, however, bids fair to be replaced for much of the year by a country habitation, located apart, amidst rural surroundings, and of no greater altitude than three stories, but of large ground area. Such communal dwellings, for four, six, or eight families, will have all the perfected equipment of the larger city apartment house, and, in addition, private gardens, groves, orchards, and rural scenery.

The kitchen will be a joint or cooperative effort, but attended by difficulties and trouble. For it is the question of improved food which will longest baffle the genius of the chemist and biologist. Nor need this be a matter for surprise. Nutrition is the problem of the coming age, *par excellence*.

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Food, as we at present view it, seems a simple matter. The lower animals and plants afford it. It has but to be herded, cultivated, harvested, and cooked. What more simple? But of all future inventions and discoveries, some of the greatest, the most important, will pertain to food.

At present we ingest the *errata* of plant and animal life. "The dead, alas, are in us," and "death is in the pot"; but less that our foodstuffs contain poisons than from lack of organic energy to maintain the complicated apparatuses requisite to reduce and make it ready for assimilation by the tissue cells. It is our food which renders greatly prolonged life impossible, at present. Nor is it probable that the human organism ever was, or ever could be, bred or trained to live forever on food such as human beings now eat. The physiological processes by which food is reduced, comminuted, corrected as to its chemical constituents, peptonized, hepatized, oxygenated, and, in a word, carried forward to higher and higher stages of chemical instability, fit for assimilation by the tissue cells — all these processes set up a heavy draught on the collective, organic life of the animal body, and necessitate the putting forth of energies, on the part of all the cells, which cause an ever-increasing deficit of potential, a growing debt from overwork, a chronic accumulation of the effects of fatigue, which, under present conditions, must sooner or later lead to a running down of the cells.

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Under favorable conditions, a cell may gain potential; but the severe, steady draught on cellular energy, necessary to maintain organic nutrition, even on the best food at present procurable, bankrupts the collective energies of the cells within a century.

The horse, ox, and other ruminants that have to do even more hard grinding and furnish more energy, relatively, to maintain nutrition, succumb much sooner than man.

In one sense, therefore, it is our food which brings us to death's door, that is to say, the exhausting physiological processes, necessary to prepare it for cell nutrition, will in the end work the most perfect existent animal organism to death.

It is only when the organism is young, the lungs pervious and the tissue cells little encysted as yet, that a gain in cell potential, for fifteen or twenty years, can be made over the draught on vital energy, requisite for nutrition.

We may properly attach great significance to these facts, since the general opinion is, that food, once eaten and drunk, reaches its proper destination in the body, without much expenditure of energy. Yet sudden death not infrequently follows over-feeding, purely and solely from organic inability to summon sufficient power to initiate the process of food reduction.

It is along the line of improved food, as well as re-

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generation of the somatic cell, that we must look for happier and longer life.

Is such a food possible?

Beyond doubt. But at present we lack the data of nutrition. We do not as yet understand how a cell nourishes itself, nor how it might best be nourished. The cell absorbs particles from the blood plasma, and we have a general knowledge as to what those particles are; but of the modes and processes of intra-cellular digestion and nutrition we are ignorant. We do not know how much of that food is actually assimilated in the cell, nor how much is rejected. Beyond doubt the blood is a comparatively dirty stream, and it is probable that the cells suffer constant injury from the dirt which they ingest. The intestinal tract, or passage along which the ingredients of the blood are prepared for the villi to engorge, is literally a howling wilderness of disgusting parasites and bacteria, many of which are hostile and destroy the life of the host if they multiply beyond certain bounds to which the *vis medicatrix* of a healthy organism keeps them down.

As a first step in the study of improved food for the future we have need to see what the primitive cell — the protozoon — has done in this line. For better food has been the object of long effort, since the first micro-organism appeared on the shores of the primeval sea. Protozoons like the rhizopods, encysted food particles which,

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laboriously, with an exertion of all their powers, they contrived to reduce, digest, and in part assimilate. It was a hard life into which they put all their energies; and to their humble efforts we owe a debt of far-off sympathy. One can but think softly of those first toilers in the archaic marshes — so much depended on them.

The protozoon had his small stomach, an improvised colon, and maybe a unicellular liver; and beyond doubt our ancestral rhizopod had his colics and his jaundices, and was often in mortal agony from terrific peritonitises. It could hardly be otherwise, considering what awful food chunks his hunger drove him to surround. But he struggled through, by hook or crook, and finally drifted into metazoic cooperation; and thus took life a little easier.

For after locomotion, better food was the first problem which multicellular creatures undertook. The animal organism, with its blood-circulatory, blood-corpuscles, blood plasma, cardiac apparatus for propulsion, and lung tissue for æration, offers a most interesting and suggestive study of the way the protozoon, in its later rôle of physiological cell, has handled the food question. It is the object lesson of the protozoon to the human metazoon.

To secure better assimilable food for brain and muscle the confraternities of metazoic cells, very early in the division of labor, constrained a certain number or tract of cells to act at first hand on food substances and make that their peculiar business, so as to get it in more available form; these

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were the cells lining the food pocket or future stomach. The labor being arduous, the metazoic consentience soon detailed certain other groups, or tracts of cells, to aid those of the stomach-sac; and these afterwards developed variously as liver, pancreas, and other glands, great and small.

Still others took up the work of passing the liquefied pabulum to those other tracts or groups whose business was locomotion or intelligent direction of the whole union of cells; and these in time developed as arteries, heart and veins.

But to be transformable to energy and carry on the physical business of the co-partnership, oxygen was needed; the liquid food must be charged with oxygen; and another cell group took up the business of admitting external air and infiltering oxygen. From this group has developed pulmonary tissue. But nerve, brain and muscle cells excrete waste products of the nature of poisonous refuse, to such deleterious extent that another cell group assumed the duty of extracting it from the circulation and washing it away; and from this tract of cells we have the renal organs.

Still there was complaint that the food was not good enough, and another cell group, entering the sanguineous current, undertook the task of still further refining and vitalizing the plasma, now on its way to brain and muscle; and from these laborers for the common weal have come the white and red blood-corpuscles.

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It is at the price of all this auxiliary labor and only by virtue of it that the brain and muscle cells are nourished and are able to live so long and do so much in the way of locomotion and intelligence. Mind would be impossible on a poorer food for the brain cells.

And what is the lesson from this? Locomotion, intellect and a lifetime of a century have been attained by the metazoic cell from a food as good as that which now comes to them in the blood plasma. Yet that plasma still contains noxious particles, despite the efforts of the living organs which labor to refine and improve it. The inference is easy. Science must come to the aid of the organic apparatus and furnish a food clean, pure and easier of assimilation.

This brings us to the fundamental question, What is food? — a question which has been variously answered. Nor can it be answered at present. Food is that which renews the cells; and the cells absorb it from the plasma of the blood; but exactly what portion they absorb, or how much of what they absorb is necessary or best for this renewal, is not known. There is doubt whether the tissue cells are renewed as to their intimate structure or that nutrition, at bottom, adds ponderable matter to the cell, or is more than a replenishing of ions. We do not know that cell food is, or need be, anything more gross than ions or electrons. That is to say, the idea has begun to prevail, that nutrition as we now know it is an

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immensely cumbersome and arduous process, attended by great strain and duress of the human organism, all of which science may obviate by presenting a food which will not require such hard physiological labor. The excretion of urea has been held to prove that there is structural waste and replenishment of cell substance. As nutrition is at present accomplished, this appears to be true, the result of a species of internal combustion from oxidation in the cell. Indeed, it is evident that the process of nutrition within each cell of the organism is, on a small scale, strictly analogous to what takes place in the stomach and intestinal tract of the larger multicellular organism; that is, that there is intracellular ingestion, excretion, and assimilation of an esoteric plasma which renews the cell. That is what appears to occur; but our question is, Need it occur? Is it anything more or better than a laborious, destructive process which may be obviated altogether by inventing a more ethereal cell food?

It has come to be doubted even whether a cell, after it has developed and grown to its full size in the adolescent organism, is ever normally destroyed or renewed so far as implying change of structure. The cell structure probably stands during the lifetime of the animal. The cell is no more wasted as to its *organella* than is the greater animal organism of which it is the vital unit. The physiological cell, indeed, is a minute organism, hav-

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ing, in many tissues, a life term contemporary with that of the greater metazoic organism.

What, then, is the actual cell food? — and the cell food is equally the food of the metazoic organism.

Keeping in mind that much of what the cells take as food from the blood plasma is food in a gross condition, which necessitates intracellular conflagrations before it is reduced, smelted down, so to speak, and sublimated, fit for actual cell food, and at best leaving a portentous residue or slag that has to be gotten rid of, — keeping in mind this fact, I say, What is the real food of the cells? What is this last product of intracellular digestion which goes to cell maintenance.

Beyond doubt it is something refined, "ambrosial," ethereal, perhaps the ion itself, the electron. We know not as yet whether there is a decomposition of the atom of carbon, or of the other elements present in "protoplasm." Is the life of the cell dependent on the restoration of the component atoms by an intake of fresh ions, set free from the incoming food-stream? And if something of this nature is found to be true, is it not quite possible that a dynamic food which may be administered directly to the cells, without combustion, waste and residue is the desideratum of life on the earth?

Why are 98°+ Fahr. of organic heat requisite to human life? Clearly because of this food combustion rather than because the cell-of-life cannot live at a lower

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temperature; life is possible below the freezing point; the cold-blooded organisms do not require so high a temperature. High temperature in mammals and birds appears to be a concomitant of nutrition rather than a biogenetic necessity to life itself. Not that animal intelligence would be heightened by a reversion to reptilian temperatures! But other methods of keeping the human organism warm could be found, methods less destructive to the component cells than by extra- and intracellular oxidation.

We are as yet, of course, at the first outer confines of this great question of cell food. But even now it begins to be evident how much depends on a better understanding of nutrition, and the great desirability of directing research in this direction, backed by the resources of the civilized world. Immortal life is the stake which science is playing for along this line of investigation. It is a true world-problem, one of those more than Herculean labors of the coming century which call for the united efforts of mankind.

At all this my scientific friends will smile and say, "Idle dreams, Utopian fancies! Mankind gives no token of such united action. Mad Mullahs, Mahdis, and Warlords bid fair to rant and run riot up and down the earth for centuries to come. Men have not sufficient knowledge

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as yet to perceive the tremendous advantages of cooperation. Personal selfishness still outweighs the larger view. The inherent immorality of a short life prompts to snatch at personal pleasure and let the next generation take care of itself. It is all a part of this horrible immorality of certain death and cannot be ameliorated as long as human life is so perilously insecure and brief. With death but a few years ahead at best, human beings will work for those few years and continue indifferent to larger interests."

All of which is but too true. And yet there is always a measure of altruism in the human heart, a balance of philanthropic good-will and a strain of generous heroism, prompting individuals to deeds of self-sacrifice for the common weal.

It is to these saving traits in us that posterity, yet unborn, makes appeal. Personally, too, we would all of us be willing to do more than we do for the common good, and cooperate in mutual undertakings more than we do, but for the impracticability of such efforts, the difficulty of initiating united action, the inertia of existent social, political and economic methods. It is this inertia of olden forms, customs, race antipathies, creeds and national prejudices among the billion and a half of the earth's inhabitants which so baffles and withstands rational progress. All of which brings us to a practical question of what can first and best be done, under the circum-

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stances, to unite the world's resources, combine human intelligence and render it effective to combat the causes of disease and death? What is the first practical step to this end? Can any plan be adopted by which intelligent persons of this generation can really get to work and bring their personal efforts to bear on the problem?

At first it appeared possible to the present writer that something could be done on a world-wide scale, and that the best method of beginning would be a world-league of science and of educated people generally, in every civilized country, irrespective of race or nation; for science is a common nation, a common country. And since there are many spoken languages and the Latin is the *lingua franca* of science, it seemed proper to call such a league, *Gens Scientiæ et Pacis*, The World-Nation of Science and Peace.

It seemed possible that scientific men and educated people, the world over, might thus organize to promote research on a grand scale, with greatly prolonged life in view. It was at once recognized that membership must not be construed as inimical to existent citizenship and allegiance to one's own country, but only as pledging members, individually, to use their best efforts to promote such researches, and in case of impending war, to avert it, by referring the matters in dispute to the already organized peace tribunals. Also in case of nationally selfish legislation, to defeat it in favor of a policy more inter-

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nationally just; and in general, to promote a sentiment of universal good-will and confraternity, having clearly in view the union and concentration of the entire strength of mankind, to accelerate researches into the causes of disease, old age and death.

It appeared possible that such a world-league, having its headquarters in the United States and an extensive membership in every country of the globe, might come to exercise a controlling influence in mundane affairs. An international peace society we already have, which has opened the way to a peace tribunal; but the *Gens Scientiæ et Pacis* would be of wider scope, uniting persons of scientific attainments everywhere, and having a definite aim: the union of mankind for the application of all science and all the world's resources in the coming great struggle to reach the acme of Natural Salvation; to protect and rescue the human organism from its present hard fate.

It was not believed that the suggested league would make much progress with the alien races, save in cases of educated individuals. The burden of all progress and all achievement will long rest with the dominant race. The lower races, like the lower animals, will of necessity be coerced for the general good and their own good. The "rights of man" are sacred only when the man is disposed to make good use of them, and is intelligent enough to do so. The right to make the world better is a divine right, the natural prerogative and duty of superior knowl-

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edge. An ignorant, ill-disposed race or nation, bent on selfish and aggressive courses, may properly be constrained to do right, even within their own ancestral territory. Men or races have no natural right to do wrong, even if never so sincere, never so self-holy.

With the Indo-European rests not only the responsibility to do right for the world, but the duty of seeing to it that others do right. This is, in very truth, "the white man's burden," the gravest of all responsibility.

In nearly all civilized countries there are now scientific associations, or what corresponds to this, which might on proper representation be united for promoting public enterprises of a scientific character. These societies and associations would serve as the national units of the proposed international *Gens*. Science, which is the mainspring of all present progress, is thus far deficient in methods of working on a world-wide scale, or even of acquainting, save by hearsay of the press, scientific men of one country with the aims and purposes of those in another. In many cases, it is not until published papers appear, that scientists in other lands gain an inkling of what cotemporary investigators are doing. Nothing like an economic division of labor in scientific research, or in the way of mutual aid, has as yet been attempted. This isolation, too, has bred a kind of jealousy and small secrecy concerning research, which obstructs rather than facilitates progress.

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Perhaps nothing less than an engrossing common motive, like that of the achievement of greatly prolonged life, will suffice to unite and bind together the scattered scientists of different countries. That motive, at least, will prove the greatest incentive to united action. The sublimity of the object and the personal stake of each and all in the success of the endeavor would quite overshadow the baser sentiment of jealousy between investigators. The biological science of the twentieth century will be, indeed, working for life's sake. This interest will become universal and intense. Each fresh discovery, each new application of remedial skill, will be flashed from continent to continent and be hailed with an ever growing enthusiasm.

When once the idea has gone world-wide that science has good hopes not only of removing the causes of death, but of so facilitating and perfecting nutrition by improved food, that the struggle and stress of living will be lifted, then will be exhibited an ardent desire to live, such as the world has never known. No longer to pant for breath, or writhe beneath the torture of encroaching bacteria, will ennoble life and endow it with a new and passionate desire to live. We grow weary of living and resign ourselves to death only because of the pain and hopelessness of the struggle to breathe longer, — a struggle which will cease in vital calm and rest when research teaches us how nutrition takes place and what chemical substances are

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the proper food of the cells, without the present hard labor of preparation.

No lengthy preamble or constitution for the proposed *gens* was thought necessary. Its strength was in its high purpose and intent. Indeed, the name itself was thought to be sufficient as constitution. And to all who are distinctly Christian, it was believed that the idea would appeal strongly as an efficient means of bringing the world in harmony with the central doctrine of the faith.

To summarize the doctrine of Natural Salvation as outlined on the previous pages, we have first of all to record and emphasize the later, better conception of matter. That protean mystery of the visible universe is not the dead, passive clay of a Supernatural Potter, wrought, moulded, and formed only beneath his hand, but is itself the Potter, both potter and clay: the basic substance of a self-created, self-moving cosmos, and infinite and eternal entity.

This sublime conception alone comports and corresponds with the evolution of mind, its desire of infinite opportunity, its tendency to unlimited growth and its hopes of immortal life. The universe is endless, the field which it offers life boundless. On the infinite breadth of Void lies outspread this inscrutable mystery which the physicist now terms *matter*, but whose real name mortal lips have

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never yet spoken, perhaps never will, never can; since to define it is to rob it of its most sublime attribute.

Whence it came, or whitherward it moves, none can answer. It is the unknown. We feel, see and study certain of its phases, but of its origin, or destiny, we know nothing as yet.

Even our present scanty knowledge of matter enables us to perceive that such are its attributes; and ever as the horizon of our science broadens and the clouds of our ignorance lift, we are led to regard matter with new awe and greater reverence. Fresh from the mutations and destructive catastrophes of a thousand world-deaths, it emerges ever new, with the same omnipotent power to create afresh. Yesterday, to-day, forever, it is the same exhaustless well-spring of motion, beauty, feeling and life.

One of the attributes of matter as observed in nature — its primal attribute, probably — is a sentient property by virtue of which it displays the phenomena which we term life. Matter lives.

The first manifestation of life of which we have knowledge is in the cell, as observed in unicellular life. Beyond doubt chemism everywhere is attended and, indeed, initiated by a low degree of elemental *feeling*, yet this property is at a great depth below what we designate as life in the cell. Cell life is the result and product of an extended organization of the lowly-sentient atoms, ions,

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or psychons, if these terms may be used as names for the most minute particles of matter of which we have knowledge. In the cell we have several billions of ions — each from its behavior a sentient particle — extensively organized to accomplish nutrition and reproduction.

Incident to the sentient property of the ions, there is a lowly degree of selfhood, or incipient personality; and when the ions, or psychons, are organized in the cell, we find, *pari passu* with the cell organization, a corresponding *bund* of selfhood, evinced in the cell personality.

It is from studies of the cell organization that we have come at length to grasp the principle and *raison d'etre* of all natural organization, namely to accomplish elevation of the lowly sentience of unorganized matter to higher degrees of sentience, having apparently as its ultimate object and end, animal intelligence and those still higher degrees of intellect displayed in the human brain.

Nowhere do we find intelligence without organization of the basic substance. The small mind of the cell exists only by virtue of an orderly arrangement of its protoplasmic contents. This small self-conscious life presupposes organization. Only by means of organization is the low basic sentience of unconditioned matter, the untrained instinct-force of chaos, raised up to intelligence.

Here is our master key to Nature: organization and intelligence, rising hand in hand from elemental matter, each dependent on the other, neither able to exist without

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the other. Mind no more able to exist without its organized body and brain, than body and brain can go on existing in the absence of the conscious and subconscious mind. The one is the corelative and component of the other. They can no more be separated, or exist apart from each other, than the elemental ion can be sundered from its primary sentient property. Sundered, were that possible, matter would no longer be matter; the universe would vanish on the breadth of Void.

This, then, is the principle which the future psychologist and theologian must grasp and incorporate, or find their doctrines as a house built upon the sands.

On the earth thus far there has appeared only the cell type of organized life, supplemented by more or less well-perfected combinations of this type. From this vast substratum of unicellular life has developed a complexity of cell unions, organized as plants and animals.

By virtue of this extended organization, the estate and condition of all the cooperative cells have been greatly improved, their tenure on life enormously lengthened, their psychic power as enormously enhanced.

From the Silurian ages there has been a continuous progress, extending upward through plant and animal life to human life in civilized communities, until as a result of the whole grand scheme of organization, we have in the brain of man the highest type of united cell life and unified cell intelligence, where the cell (neuron) now lives a

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hundred years, and by further progress may become immortal.

And it is to this entire cooperative effort of life-on-earth to improve its condition and preserve itself that we have given the high yet humble designation of *Natural Salvation.*

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At the Darkest Hour

The Hour Before the Dawn

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AT THE DARKEST HOUR.

THE HOUR BEFORE THE DAWN.

FROM many points of view the opening of the twentieth century is humanity's brightest hour; the brightest, the most hopeful since life first took root on the earth. Scientific discoveries are multiplying and open vistas of promise that even while they startle encourage us to hope great things. And other grander discoveries are, beyond doubt, at the threshold. There is a thrill of expectancy in the air of these opening years of the new century; a new faith that all which has preceded will soon be surpassed.

Inventions have prodigiously increased the powers of men to contend with nature and deal with material substances. Foodstuffs have been improved in quality and variety. Civil liberty to live has become better assured; transportation made easy, rapid and cheap. Throughout the length and breadth of the earth, the press, telegraph and telephone diffuse intelligence swiftly, and also enable public sentiment to find expression. The industries are organized and systemized as gigantic agencies for human

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advancement. Wealth, too, is wonderfully increased and, despite all complaints and forebodings, was never before so evenly and justly distributed to all men. Never even in the fabled Golden Age have all men, irrespective of rank or birth, shared the advantages which wealth confers so equally. Not that such distribution is yet ideal or complete; far from it; but the present complaints, forebodings and *emeutes* are themselves the signs of a progress in equalization. In no former age and at no previous time has the so-called "poor man" enjoyed so generous a share of the world's wealth. The laborer at two dollars wages *per diem* reads the same newspaper, rides in the same car, attends the same amusements and eats much the same food as his wealthier fellow and, if he pleases, may live in a house equally sanitary, if not so large, and lie down to sleep on an equally soft spring mattress. The mere possession of a great fortune, indeed, now gives the possessor more care, but little advantage over his less opulent brother-man. Curiously enough wealth comes of itself to be the instrument for making all men equal.

When we consider the humble beginnings of organic life on the earth — developing as it has done from the primitive unicellular life — the spectacle presented by humanity at this epoch is one of reasonable promise. From the protozoa multicellular organisms have developed; and from these lower animal forms, man has arisen. It has been the slow work of millions of years; but it has been done

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so surely and the progress has, on the whole, been so uniform and so well defined, that it appears highly improbable that this great evolutionary effort is to end in mortal man, incomplete as he is, with his many capacities for further progress undeveloped. Such stupendous balks in the order of nature occur only along the line of catastrophism; a cosmic catastrophe involving the solar system might suddenly or slowly, end all things terrestrial. Otherwise a reasonable expectation obtains that humanity will make progress in the future as in the past.

What inclines many students of history to take hopeless views of man's future on earth is the contemplation of races, peoples and nations that have risen to a degree of greatness and power, and then declined. At short range observation the Seres and Hindus, for example, seem to furnish evidence that man can move through but a circumscribed arc of progress; that the Cambodia and China of to-day inevitably succeed every upward saltus of mankind. Egypt, Chaldea, Persia, Greece, Rome, Baghdad, all present similar instances of rise and fall. If the student restricts his view to the history of any one nation in the past, he may be led to form a similarly hopeless opinion. The progress of humanity cannot be estimated by what takes place in any one quarter of the world, during any one century, or thousand years. Contrasted with what the world was in the days of Pericles and Augustus, who could have seen any hope for humanity in the year 700

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A. D.? Yet the greater era of the Anglo-Saxon has succeeded, in due time.

In the large, mankind has developed by rhythmic advances and pauses. Collapse has followed each upward career; but always something grander succeeds. Ten thousand years is the briefest time period by which the progress and probabilities of the genus homo can be correctly measured. Ten thousand years, indeed, is but a yesterday in life's great curriculum on this planet.

Regarded in this larger light, and from the standpoint of progress in the physical sciences, art, and invention, humanity is at its brightest hour.

Grand, hopeful, and benign as is this progress, so prophetic of a mighty future for humanity, it is none the less tinged with an ever-deepening sadness for each and all of us, personally. A magnificent future is dawning, but we shall not see it. A few months, a few years more at most, and personally we must close our eyes in death, and drop back into the insentient void. In truth, it is this very awakening of the intellect, this latter-day vision of the future, which renders death so grievous, so inopportune.

It was not so with our ancestors. Life was a struggle too hard, too grim, to be greatly prized *per se;* the ills of life were numerous; they suffered from heat, cold, famine and the malignity of foes. The pleasures of life, too, were chiefly sensory and fleeting; hence their mental

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attitude toward death was one of comparative indifference; continued life offered too little to be very earnestly desired. This sentiment concerning death prevails largely to-day in the Orient and among savage tribes. Life is not wholly desirable, often the reverse, it holds so little of real enjoyment, so much of pain, fear and general misery.

The case of the well-to-do, well-lodged, and happily environed American of our own times is wholly different. Every day may be a pleasure, devoted to fresh achievements.

The youth of to-day, moreover, has need of vastly more time to realize his expanding ideals. Hitherto it was a hut, food and a wife that formed the sum of a young man's ambitions, the goal toward which his life developed: all obtained during twenty years of youthful effort. The aspirations of men have vastly enlarged. Fifty years scarcely suffices to realize the plans necessary to success in life. Formerly when the pleasures of life most sought were sensory, the realization was not far to seek, and when attained the vital *vis viva* slackened. But the pleasures most prized by the educated young man of our times require a longer initiative, three or four decades of patient study and sustained exertion. Life and the purposes of life are laid on wider lines for a loftier superstructure — the kind of living that outgrows the brief lifetime of our forebears.

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Our ancestors, too, were solaced by pleasing illusions concerning a mythic life-after-death. The "soul of man" was believed to live on, disembodied and self-conscious, after the body died. The founders of religious cults made skilful use of this illusion and framed vast systems of ritual and dogma, in confident reliance on which millions lived and died, and even rushed to death, recklessly, battling for creed's sake. The second of the great religious systems of our era was successfully propagated and has been maintained by promises of paradise to those who fall fighting for the faith. The devout Christian regulates his life with reference to "heaven," and dies in the hope of going thither immediately after death, — and this although the Founder of Christianity apparently taught that the kingdom of God was the earth.

The point here made, however, is in effect that in past centuries, so far as human beings have aspired to longer life and desired continued existence, the aspiration has been satisfied by a partial faith in "soul" life. Such belief has sufficed considerably to assuage the pang of dying, and incidentally has led the devotee to despise corporeal life and disdain the earth as an abiding place. This, indeed, is the spirit and morale of Christian and Mohammedan life. Terrestrial life is subordinate and desirable only as a period of preparation and a point of departure for a paradise beyond the grave. This has been the consolation and the mental attitude of our fore-

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fathers. We are not here discussing either the truth or the reasonableness of this faith. It is enough to say that the consensus of scientific knowledge precludes it and robs us of such consolation. If the doctrine of evolution and all that we know of life and living matter teach anything whatever, it is that the dissolution of the brain and spinal cord is the end of the conscious and subconscious life that subsisted there. Our efforts to preserve a semblance of faith to the contrary but embarrass and delay the growth of knowledge. The biologist of to-day faces the fact that death is the end of personal life. It is no longer the ladder to heaven, but the brink of unconsciousness.

Psychical research has accomplished nothing to alter or relieve this fact, nor is there the slightest reason to believe that it will or can do more than emphasize this "hard condition of our birth." We of this generation share all of primitive man's instinctive shrinking from death — the natural abhorrence of death which all life exhibits — and, in addition to this grief, we foresee the grand future of man on earth and perceive that for us, like the Hebrew lawgiver, there is nothing but this early glimpse from a mountain top afar. We live too early to enter the land of the great achievement. We shall not quite pass from death unto life. For us death will still be an irremediable evil.

But death is not an evil, many thoughtful persons will

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rejoin, or, if an evil, it is, at least, a necessary one. What greater calamity could befall humanity, as human society and human civilization are at present established, than to have the passing generation not pass off, but remain on the crowded stage of human life? Even war and the slaughter of thousands is, by not a few political economists, regarded as a beneficial event for relieving the social congestion of overpopulated countries. If immortality were achieved, starvation, suicide on a national scale, infanticide, or the execution of aged persons would ensue from a necessity.

These are views which are fairly pertinent, although, properly administered, the natural resources of the earth are undoubtedly adequate to the sustenance of six billions of inhabitants, without crowding or poverty, in the place of the billion and a half who now dwell on it. This latter reflection does not meet the objection of overpopulation, however. Nor is it necessary to meet it, in the sense of providing field for a vast population, since Nature herself has already met it in her plan of vital evolution. The procreative instinct is intensified or diminished in ratio with the duress which human life encounters in the struggle for existence. With the hard-worked and short-lived, children multiply rapidly. Where all the conditions of life are hard and evil, procreation is active.

On the other hand, education, refinement, ease, leisure and the prospect of a long, happy lifetime redound not to

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increase of population, but rather to diminution. So markedly, indeed, has this been found to be true, that the inference is a fair one, that were enlightened persons, men and women, freed from the fear of death, the cruder pleasures of procreation would be foregone, from choice, for greater and purer joys in a life of a higher type. We may, at least, reply confidently that those who are able to achieve greatly prolonged life for themselves will not overpopulate the earth.

More specifically death often is not an evil, but a blessing to the hopelessly diseased, infirm, and decrepit. Death may even be voluntarily and logically sought by the hopeless sufferer. There are grave doubts whether, if nothing better were to be hoped for in the future by humanity than life as the majority of our fellow-creatures hold it at present, — grave doubts whether unconsciousness were not better than the burden and pain of their lives.

These phases and negations but prove the converse of the question, however. The primary instinct of life is to live. Nature, *ab initio*, makes oath that *to be* is better than *not to be ;* nor have all the consolatory sophistries of creeds ever really convinced a human being of normal intellect that he will live on personally conscious, remembering and seeing, after the death and dissolution of his body. Such "faith" may assist a little to mitigate the bitter pang of dying, but never fully reassures ; the common sense still perceives the real situation, and cannot,

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even in its ignorance and weakness, wholly believe the kindly meant promissory. At best we resign ourselves to lapse from life with a shudder and a sense of awful heart-break, and on the brink of the great darkness shrink back, and, feebly struggling to breathe again, turn our dim eyes to the beautiful light.

Man has literally fought his way upward; he has battled for life and supremacy, first, with the fiercer orders of the carnivora, the cave-bear, the machairodus, then with his fellow-man for political and moral freedom. His last grim foe is death. "The last enemy that shall be destroyed is death." But as yet —

> "Death reigns. Dust unto dust must go.
> The nations wail of their dread foe.
> The bitter waters of that Wormwood star
> Which burns malign, from pole to pole,
> Are to be drunk. Who may console
> Their mortal woe? Outwelling from afar
> The grief of worlds bewails its dying pains,
> A cosmic dirge, moaning it comes, Death reigns."

To all normal, healthy life, death is unquestionably an evil. Nature has nothing in common with those theorists who, making a virtue of temporal misfortune, seek to persuade man that death is a blessing. Scant must be their souls. Man has developed to live, not to die; and time and space given, man is omnipotent.

How much of literature is a dirge, a cry of mortal

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anguish for friends departed, for self departing from the joys of life! Dread of death is the spur which will drive men to the achievement of prolonged life.

Over all the past and the present hangs a pall, shot only by the bright intuitive hope that death is not a final law. With the Romans *Mors* was a goddess in black robes, with ravenous teeth, hovering on sable wings over the whole theater of life, darting hither and thither, snatching its prey. The imagery comports with the Roman character.

With the Greeks *Thanatos* was a god whose reign men mourn, whose mission is to nip the joy of life and blast the well-springs of hope. At his approach they shrank and cried, "Eheu! Eheu!" The conception is characteristic of beauty-loving Hellas. Her children ever shrank from that cold, dark realm where there was no sun. The despairing cry of Electra utters the Hellenic sentiment touching death. Burdened as was their faith with the tenets of Egypt, death was still to them the end of pleasure, the tomb of joy. The Greek poets sometimes symbolized Death and Sleep as brothers, twin boys, lying asleep in the arms of their mother, Night; and again Death as a winged boy with sad, white brow and inverted torch; at his feet a butterfly. These last were poetic fancies rather than popular conceptions.

The Hebraic portraiture of death was a solemn and august angel, flying forth from God, armed with a sharp

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sword to slay the children of men who had sinned. Hence, the strange description of death in the Apocalypse.

To the Hindu death was personified by the soul of Yarma (Adam), the first man who died (according to their tradition), and who thus became the monarch of the dead.

Our old Norse ancestors thought of death as a cold, misty presence, rolling darkly on, like the whirlwind storms of their own northland, wintrily enveloping its victims and sweeping them away, enwrapped and lost from sight forever. With them death was associated with the bleak, elemental forces of the air, the sea, and the night, caught in the strife of which they so often perished.

In our times and in all time the vulgar imagery of death is a skeleton. Death makes a skeleton of man, hence man makes death a skeleton. In such grisly representation he foresees his fate. It was reserved for the grandeur-loving genius of Milton to draw death at once awful and truculent: —

> " The shape,
> If shape it might be call'd that shape had none
> Distinguishable in member, joint, or limb ;
> Or substance might be call'd that shadow seem'd
> For each seem'd either, — black it stood as night,
> Fierce as ten furies, terrible as hell,
> And shook a dreadful dart ; what seem'd his head
> The likeness of a kingly crown had on."

It is a curious fact that death, which is a nonentity, has always been typified by substantive imagery. In a word,

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the utter absence of energy, or force, has been idealized as a monster of the most forceful character. Fancy has run away with fact. Death is *nothing* in itself, the synonym of nothingness, and has never been better defined than as the absence of life. Matter is inherently endowed with that which may become sentient. The human intellect, with this element of immortality within its grasp, shudders and sighs to cease. When the real situation shall become evident to human vision, a new era of mental activity will dawn. No longer vainly praying for miraculous redemption, man will arise to work out his own salvation, and labor for an immortality which will have no uncertain hold on his faith. The task is mighty; but a grand idea never yet perished for want of soldiers. Man, at least, has this record for his encouragement. Men would not be worthy of immortal life, would not be fit for it, if they cannot achieve it for themselves. Whenever in the past man has risen superior either to brute beasts or brute passions, it has been by his own unaided exertions. However piously he may have prayed and trusted, the fight has always been his own. Overmatched, the good and the bad have always been crushed alike. God is not on the hither side of matter. What is on its far side we know not. Yet Right, in the long run, appears to be a better soldier than Wrong. We may, if we please, fancy that God put this ingredient in matter and, having done that, retired to Olympus.

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But during twelve hundred years the average of human life has not been raised more than twenty years, at most, what hope, then, of greatly prolonging life in ages to come?

The reply is that the outlook cannot be correctly estimated by this past slow gain on death. Through what unwritten ages did man wander over prehistoric continents, a wretched, fireless troglodyte, a feeder on acorns and berries, yet in one brief moment the first spark of fire was struck, — fire which made him the rich owner of all the metals, which opened a new realm of comfort, warmth, and food and spread the race over vast regions hitherto uninhabitable. In that single moment man rose to a higher plane of existence.

Within historic times, but four centuries ago, human progress was vastly accelerated by a single discovery, which was little more than a lucky accident. Up to the times of Gutenberg, what progress had been made for three thousand years in the art of book-making? Till then, books had been laboriously copied with stile and pen and so far as any one could then have foreseen, bade fair always to be thus tediously reproduced. A copy of the Scriptures cost from two to three thousand dollars, equivalent to six or nine thousands in this century; but a single decade saw the art of printing born.

Dogmatic unbelief may be as greatly mistaken as dogmatic faith. The times are ripe for great discoveries

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touching life and its co-relative modes of energy. The epoch — and it will be the grandest of human epochs — when the protoplasmic molecule shall render up its secret to human scrutiny is near at hand. Man will then be no longer the abject serf of death, but a belligerent, contending for his freedom, with the prize of unlimited life before his eyes.

There are, it is true, degenerates who aver that all life is an evil. There are clubs that seek out, ponder, and discuss modes of euthanasia. They should be wished success. Such pessimism is an evil diathesis, a mental malformation of which the world would be well rid, by the shortest method. But we are speaking of normal men, not of posers, perverts, drug-bemused manikins and alcoholics.

For the normal man of science a new and sterner gospel is requisite. The awakening from dreams of paradise has come, and in very truth we have little enough to requite us. The devotee has much the more of solace, and many there are who will prefer the sacerdotal promise to the grim reality. It is so much easier to accept the gilded promissory of the established church than grapple with the real problems of life! Confessing one's sins is so much simpler than actual reformation! What wonder that the earth groans beneath a weight of mosques and cathedrals, or that four continents glisten with church vanes! Devotee and priest have this advantage: they

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die with great hopes and will never learn their mistake; whereas the man of science dies with the certainty that his course is run. Science, alas, has added a pang to death for all her children. It has dissipated the beautiful mirage of dying men.

> "Let the grand future pity those whose weakness
> Had to be fostered by a foolish hope;
> Perhaps without it man had died, the Earth
> Gone fallow to its dead-orb, lunar age."

Without it, perhaps, men could not have been led or driven to work and fight. Temple and pyramid would not have been reared, nor needful experience in architecture been gained. Greek and Trojan would not have sailed the Mediterranean, nor the Hebrew slave fled from bondage to seek his Promised Land.

As soon as man rose a little above his brutal ancestry, as soon as he began to think, to ponder what he saw, he was aghast at death. He would not face the hard fact and persuaded himself that by prayer, burnt offerings, pilgrimages and self-denial, he might escape extinction. The mirage of his hope rose and loomed before his life-thirsty eyes. Erelong, then, as might be predicted, certain guilds took up the business of exploiting the mirage. That the guild itself was often sincere and benevolent does not materially alter the facts of its origin or its tendencies. For guaranteeing the mirage to be genuine Celestial landscape, priest and Levite have been the

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great ones of earth. Humanity is still in its childhood, but now approaches adolescent years, the age when youth becomes incredulous of fairy tales. And, lo, in place of this illusion of the world's infancy, we are opening our eyes to the greater, grander gospel of manly endeavor and achievement.

If in these papers the writer appears to play the part of an iconoclast, a ruthless breaker of the sacred images of human faith and religion, it is not from any joy that he has felt in the task. Rather pain.

It is impossible to speak without emotion of that fond Hope of dying men which it is the thankless office of our science to pronounce baseless. So much of solace has centered in it, so much of consolation for the pangs of death; such sweet anticipation of future reunions with dear ones dead have grown up about it, such halos of comfort in adversity, such visions of redemption by Grace, such long ladders of creed, ascending by which we have hoped to scale Heaven and Immortality. Creeds so venerable to the human heart, so firmly implanted in the woof of brain, that the uprooting of them can but cause widespread confusion and consternation.

Such consternation and pain, indeed, that not a few will deem it illy done, if true. It has even been held that humanity would not survive deprivation of this its fond hope of "spirit" life, but like a flower deprived of moisture, would wither on a desiccant earth; that man-

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kind, thus bereft, would shrink in a premature involution to its origins; that the genus homo, shriven of this tenet, would decline to some beastial Ape-type, some senescent, frustrate Order of the Earth-born.

But take heart, ye of little faith. It is but the natural growth of knowledge. The coasts of our Race-life are strewn with the wrecks of great Religions, the old hulks of once mighty creeds, the jetsom of a thousand once fondly cherished tenets which buoyed millions in life and consoled them in death. They were, but they are not; and this is but one illusion more. Ra and Osiris, Baal and Zeus, Og and Duiron; Tau and Brahm, Odin and Thor; and more remote in the vasty past, glimpses of a hundred ancient cults, once very precious to man, now but vanished superstitions. Once they rang all true to the human mind, and gorgeous the pageant, sonorous the ritual; for a "superstition" is but a religion outgrown; and the great plains of the past are covered with their white bones. The Ararats of philology are overstranded with the quaint-carven timbers of these old arks of religious safety, arks which once carried the world's salvation, but which now lie high and dry, deserted by man and beast. For if priest and devotee could only think so, that is the best thing about religions — they are left behind when the crisis or era that had need of them is past.

There were darker aspects. It has been characteristic

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of each and every great religion in turn that it arrogated to itself all the truth in the Universe, denounced every other as wicked and kindled fires of relentless persecution. Each in turn was the one and only revelation from the true God, the others devil-born.

That, indeed, is the hardest thing about them all to forgive, or to have charity for: their horrible intolerance of each other, their ridiculous bigotry, their disgusting self-righteousness. Each in turn, Christian, pagan alike, no sooner acquired power than it reddened the earth with blood, the sky with torture-fires. Sincerity there may have been, but a sincerity merciless, murderous, abominable.

"O ye who walk the Narrow Way,
By Tophet flare to Judgment Day,
Be gentle when the heathen pray."

But gentleness there was none. From the Stone Age to Mecca and Rome, innocent blood cries to heaven against them all.

It is these dark pages of man's religious history which oftenest make us despair of his future, and which sometimes lead even the optimist to doubt whether the great brain-ape is really worthy of preservation in the universe.

"So many sects, so many creeds,
So many paths that wind and wind,
When just the art of being kind
Is all this sad world needs."

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It was this terribly difficult "art of being kind" that Siddhartha sought to inculcate, yet no sooner had Buddhism become an established religion than it inaugurated saturnalias of persecution.

It was the gospel of brotherly love, mercy, and cooperation that Jesus taught, as the corner stone of his "Kingdom of God" on earth. "Love one another" and "resist not evil." The early Christians were thrown to the lions, unresistant, and dying, prevailed marvelously over the whole world; yet no sooner was Christianity formulated as an established religion, than Christian Rome exceeded the cruelties of Pagan Rome, and taxed all human ingenuity in search of devices for torturing.

So it is well that religious systems pass. No calamity is so great as their survival over time. Buddhism, Mohammedanism, and the Christianity of Constantinople and Rome are now among the greatest obstacles to human progress. Help them to pass, not to be perpetuated.

It is, in very truth, a sterner gospel into which we of this generation have to be baptized. We have partaken of the tree of knowledge. The pleasant illusions of man's early creeds have been brushed ruthlessly away. We face Nature's hard law with no fairy tale to disguise its inclemency. Immortal life will be achieved by the aid of applied science; it is what the whole scheme of evolution

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moves forward to; it is the dream of all the long-suffering ages of man; it will be initiated on earth within three centuries, perhaps within two, so rapid is the growth of knowledge, so accelerated the march of discovery. But we who have to initiate the great effort will not look upon the dawn of the achievement, nor be among the first of the sons of men who rise superior to death.

We can but feel, therefore, that we live at humanity's darkest hour — the hour before the dawn. We live too late to be buoyed and comforted by the illusions of religion, too soon to reach the goal and snatch our lives from the grasp of death.

Have we the strength to work on, quite the same, and bravely round the curve for the sake of those more fortunate who shall come after us? Have we the devotion to face the inevitable, turn in our best work and die, uncomplainingly? Shall we demonstrate the spirit, intent and real meaning of the doctrines of Jesus Christ, or see these grand doctrines lapse to a vacuous ritual?

A thousand centuries of life's hard struggle on the earth cry out to speak through us, and bid us win the promise of evolution. We are born to this post of honor and duty. Untold labor and pain have confided it to us.

Are we worthy? Or shall we quit the task, malinger, turn sensuous, skulk back to cover of illusion and cease to be progressive?

If stronger beings on other spheres of space are

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watching us from afar at this dark hour of our planet's evolution, may they infuse patience and courage into our hearts. We have need of them.

To minds normal and unperverted, Natural Salvation is the most natural thing in the world, the outcome of life which would be expected. But it is a curious commentary on the mental condition of people that the idea of being saved from death by natural means *often appears to them strange and unnatural!* Not unfrequently as something portentous and "wicked"! That higher life, which can only be attained by the loftiest culture of the human intellect, *is feared to be impious!* The fetters of old creeds are still firmly riveted. A few, indeed, and those of the best, recognize the truth; but a majority still cling to the fetish of ghost life, and incline to the belief that humanity will run through a cycle of evolution, decline toward the lower animal orders and, in the end, perish from off the earth. They fail to see the significance which attaches to the steady growth of the human brain, a growth which separates and distinguishes mankind from all previous animal orders; and they ignore or depreciate the grand fact that scientific knowledge, accumulating from generation to generation, is changing the entire course of lower nature in man. That lower course of nature is still their criterion for the future.

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The idea of Natural Salvation as the result and outcome of the evolution of life on the earth is still too novel, too startling, to be accepted without a period of mental incubation. It is too subversive of old beliefs to be entertained without a struggle against it; or, at best, the new belief must have time to be born and grow up. And there must be further demonstration and a long balancing of the evidence. The incubus of indoctrination is still heavy; nor will the effort to attain Natural Salvation begin in earnest, until the truth and the facts concerning the "soul" of man are understood and accepted; perhaps not until children are taught the simple facts concerning the course and promise of life on the earth. The effect of two generations of such instruction would be decisive and marvelous. Little can be done till the brains of children are liberated and saved from the prevalent theological untruth as to supernaturalism. As fast as begotten and born the brain of successive generations is now handed over to this bondage of the unnatural, these fantasies of the Orient. No child among us is permitted to see life in the light of nature. The young cells of their tender brains are indoctrinated in the cradle. They never behold the universe in its true light, nor know what life really is or signifies, but walk through their span of years in a species of doctrinal trance. What genius among educators will rise to deliver unborn brain! In very truth he will be another of the Christs of men.

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And so slowly and at such sad disadvantage we must seek to instil the truth with patience against the inertia of old creeds.

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Brain:

A Still Progressive Tissue of the Human Organism

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BRAIN:

A STILL PROGRESSIVE TISSUE OF THE HUMAN ORGANISM.

WHETHER a higher type of life will enventually develop from humanity, whether, indeed, the human organism is capable of being greatly improved, was one of those questions which early suggested themselves to biologists of the Darwin era.

The argument and the inference from evolution was, in a word, that man as found on the earth is the long-descended heir of the developmental effort, — the effort of living matter in the cell mode of existence to improve its condition and rise to the highest possible degree of intelligence and happiness. On *a priori* grounds, there would seem to be no good reason to infer that a struggle extending through millions of years, and involving so much of individual sacrifice, may not eventuate in a correspondingly grand future achievement. Evolution, in fact, naturally ushers in a moral and a creed concerning man's past and his future.

As to the further progress of the human organism, however, there are many indications which appear to contro-

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vert the affirmative view. Not a few of those whom we know to be best equipped for forming an opinion on this subject, appear to hold negative views, to wit, that the human organism has long ago reached its type limits, limits which under the most favorable conditions it could not escape; in short, that the human type, anatomically and physiologically, is now "fixed"; that improved conditions will but cause it to vary within certain unsurpassable bounds; that man will remain a man henceforward, under whatever stress of evolution, continued even for many thousands of years, or forever.

When we examine the subject historically, there is much to confirm the above view. Apparently the human organism was as perfect four thousand years ago as at present, and differed in no typical features or essentials. There seems to have been no change to indicate physical evolution within the historic period.

From a histological point of view, too, there is little to indicate even the most slowly-progressive development in most of the tissues of the body; for example, the osseous, muscular, connective, cartilagenous, and epithelial tissues. The cells of these tissues pass through a well-defined cycle of growth, and give rise to a series of growth products which vary, indeed, from youth to age, but show no secular change from generation to generation.

Moreover, the bone, muscle, cartilage, and other tissue cells of man resemble very closely those of the lower grade

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mammals, the types of which are even more clearly seen to be permanent and unprogressive.

Cataclysmic changes of the earth's surface, giving rise to new geodetic, climatic, and atmospheric conditions, might, indeed, if not too suddenly destructive, compel certain skeletal alterations and changes of form, both in man and other mammals, although there is the greater probability that such catastrophism would prove fatal to all well-established types of life; in brief, that the genus *homo*, or the genus *bos*, would perish off the earth sooner than develop into anything else.

There is little likelihood, however, that further evolution will be fostered by such means, the earth itself having reached an age and a permanence of planetary type, so to speak, when surface mutations of such revolutionary character are not to be looked for. The very permanence of his terrestrial *habitat*, in fact, is against the further evolution of the human organism, or the development of anything superior in the way of organic apparatus from such causes.

The widest view of this subject of organism and evolution which we can take is so conclusive to this effect that the theory of a higher type of being than man, hereafter to come from terrestrial evolution, has been practically abandoned, even although it is apparent and can be shown on good evidence that man in his mind, his intellect, and his brain is still progressive and manifestly capable of much future progress.

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The general conclusion has obtained that evolution in the ordinary sense has terminated in man, and that he is not only the latest but in all probability the last of the mammalia. A great deal in human creed, mythic, classic, and Christian, has originated here, namely, on the hopelessness of doing much better on the earth; and hence the prayerful appeal for a more favorable theatre for life elsewhere.

The apparent cessation of evolution on the earth has long been felt to be disheartening; literature is burdened with it and aspiration concerning some other better state of existence has grown out of it.

But has evolution ceased? The question, which the anatomist and biologist have been not a little inclined to answer in the affirmative, is exceedingly important to the morals of humanity. Has the anatomist, the biologist or the physiologist overlooked any point, any particular, or any capacity by virtue of which man may still demonstrate himself progressive and take heart for himself and his race?

It is the purpose of this brief paper to call attention to one important tissue of the human organism which can be shown to have been steadily progressive, and which gives no evidence of reaching, or of tending to reach, type limits.

I shall show furthermore that it is by virtue of the steady growth and development of this part of the body

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that man has so prodigiously surpassed all other species of mammals, made them subject to him, and overrun and dominated the whole earth. In the physical sense, the evolution of this tissue has been strangely overlooked by many, in fact most, biologists, or, if touched upon, has not been held to determine the question of man's true position as a progressive mammal, compared with other species which are either unprogressive or retrogressive. For while all have abundantly recognized man's mental superiority to the lower animals, and connected it vaguely with his larger brain, this superiority of intellect has been attributed to a certain adventitious endowment of the nature of "soul," not a natural part of the organism, but an implantation from an extraneous source. Nor have biologists clearly pointed out as yet the relative truth of the matter in connection with man's rise from brute life to the estate of a world-dominant being.

The human organism, from the latest standpoint of science, is a compact, federal union of thirty or more differentiations of cell life. Every one of these thousands and millions of cells of which each tissue is composed, is a more or less independent creature, possessing to some considerable extent individuality and self-direction. They are banded together, however, indissolubly, and in certain situations are in protoplasmic contact by means of living filaments, so sentiently that all live and feel as one.

These orders of cell life thus confederated have, in the

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progress of organic development in the past, become mutually dependent and inter-dependent one upon another until one order cannot live without the presence and function of the others. Such are the bone cells, the muscle cells, the connective tissue cells, the hepatic, pulmonic, splenic, intestinal, spermatic, epithelial, capillary and glandular cells; an extensive congeries of diverse tissues, each containing millions of individuals and all mutually dependent on the general well-being and safety of the organism.

So far as can be judged by a comparison of man to-day with man in earliest historic times and man with the lower unprogressive mammals, all these above-mentioned cells, or differentiations of cells, are no longer progressive. Even their abnormalities are unprogressive. For the good reason that there is nothing in the terrestrial environment which now calls for a re-adaptation; nor has there been for thousands of years. The type of cell has assumed permanence.

There is, however, a tissue of the organism, an order, or differentiation of cells, which we have not yet mentioned, namely, the nerve and brain order. In brain and nerve we contemplate a colony or order of cells, incorporated within the organism, living at the expense of the other orders, devoted to the acquisition of knowledge: a function diverse from all others, nobler than all others. In a sense, it is as if this brain order were a superior parasite

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which had entered the multicellular organism and lived on it, but repaid for its protected situation and its refined food by doing the thinking, planning, and caring for its host. So greatly has the function of acquiring knowledge ennobled the brain group of cells, raising it to such divine eminence over all others, that in man it has come to stand for the personality of the organism, the self, the ego, the soul of the human body.

Nerve and brain are not found in unicellular life; at least, not in the organic sense of these terms.

From as close a study as can be made of certain simple forms of multicellular creatures, which are doubtless quite similar to those from which the higher multicellular forms were originally developed, the first rudimentary attempt to establish a nervous system consisted of a living protoplasmic thread, thrust out from one cell to another. At first this would appear to have been a mere "feeler," but in time it came to remain constantly extended, no longer as a transient feeler, but as a permanent means of sensory intercommunication between cell and cell.

But, as multicellular creatures waxed larger, and differentiation of the component cell orders began, simple filaments of protoplasm, modified pseudopodia, were no longer sufficient for transmitting sensation from tract to tract; whole rows or lines of cells were involved in the strong currents of sensation that passed to and fro, and, in time, these cells became devoted wholly to the business of

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receiving, interpreting, and transmitting the aggregated sensations of all the millions of individual cells of which an animal organism is composed.

I need not here review the evidences and the argument by which it is now shown that sensory ganglia for perception and reflex perception, grew up at the intersection of the primary nerve filaments; how the special sense organs took form; how at length the cerebellum came to be lodged in the forward end of the pluricellular animal, and how the ever-increasing need of greater capacity for the sensory business of a world-roaming organism led to that enormous superaddition to the cerebellum, known as the cerebrum.

What is designed here to point out is the fact that the nervous system of the human organism, particularly the cerebral portion of it, or, in other words, the tissue of mind and intellect, has always been in the past and is to-day a progressive tissue. It came into existence, as brain, in response to a necessity on the part of the organism for greater protoplasmic capacity, for the reception and utilization of intelligence. That necessity and that stimulus still exist and grow constantly more urgent.

Bone and muscle cells have developed to the extent of the necessity which led to their differentiation; the incentives to locomotion and organic support remain the same, unchanged in character; hence, bone and muscle cells long ago reached the acme of their development.

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The same is true, or true in large part, of every other tissue of the body, save the encephalon. The brain is still forced to develop and grow larger in response to constantly changing conditions incident to the world's growth in knowledge. Certain tribes, races and peoples, it is true, adhere to habits and modes of life largely unprogressive, and, as a result, show little brain change from generation to generation. It is not so, however, with the westward-moving peoples of the dominant races, — the nations who think and invent. Science is the agent of brain growth. To think, in the true sense of the word, signifies brain development. New inventions stand for cerebral evolution. The changed sensory experiences, too, which result from new inventions, tend to alter the protoplasmic arrangement of the brain, and add to its capacity for growth. In America, to-day, we see heads of varying sizes and shapes, not only the types emigrant from Europe, Asia, and Africa, but types and sizes unknown before in any country. There is actual brain growth among us. A new variety of intellect is being developed.

A comparison of the earliest human skulls, found in ancient caves, tombs, and mounds, with those of individuals of the present age, shows that on the whole there has been growth of brain as well as a perceptible alteration in shape in favor of greater intellectuality. Brain has grown greatly in size and improved in form during the last eight or ten

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thousand years, — a period of time relatively brief when considered in comparison with the developmental epoch of mammals.

Prehistoric skulls are smaller and less prominently developed, frontally, than those of our own epoch. The same general truth is exemplified when the skulls of existent savage tribes are compared with those of individuals from the highly civilized and progressive nations; there is less of that higher frontal development in savages, which we always find associated with the growth of intellect, and this even in instances of large individuals, where the skull is very massive and capacious. Acquired knowledge and the sciences tend constantly to increase the bulk of the brain and modify its form; in a word, to render it a progressive tissue.

This proposition is still more grandly exemplified when the evolution of life on the earth is contemplated as a whole. In early metazoic life, brain was scarcely more than initiated. The lower vertebrates have small brains. But in the quadrumana the human brain is found to be outlined in type and form. From this order of mammals the progress of the human brain can be readily traced.

Nor can it be doubted, even although our microscopes fail to show the fact, that the brain tissue is receiving a progressive, internal development, corresponding to the intellectual growth of humanity.

For the human brain to-day is the protoplasmic corela-

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tive, the material counterpart of the entirety of human knowledge; and in future as science increases its range and its acquisitions, there cannot fail to be greater and greater stimulus to brain growth and increased cerebral capacity.

It may not be wholly irrelevant here to allude to certain recent attempts in the province of surgery to open the sutures of the skull for the purpose of giving the brain greater room therein. These first rude efforts may be prophetic of measures which will be resorted to as time goes on to facilitate cerebral development, since it is already known to many specialists in brain disorders that congenital lack of room for the brain inside the skull is a serious incident in the lives of many persons, particularly where for several generations there has been a tendency to intellectual pursuits.

So surely as there are new things to learn in the great universe around us, just so surely will the brain of man go on growing and developing greater capacity for the reception of knowledge. It is in this respect and in this tissue that man has not reached the acme of his powers, and that evolution has not ceased.

And this aspect of his future brings us more clearly to a contemplation of his anomalous position on the earth today. From some reason — either a hint dropped in his earlier ear by beings from some outer orb of space, or in the natural order of his terrestrial development — man

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left the rank of his brutal mammalian congeners and began to use his brain. As a result, his brain grew and has entered upon an era of development the limits of which no one can foresee. In consequence we find this tissue to be still progressive, but associated in the organism with a score of other unprogressive tissues which tend but to pass through a fixed cycle of growth and decline. It is this condition which affords the key-note and the explanation to his strange creeds, aspirations, superstitions, hopes, and fears; his optimisms and his pessimisms; his gods, his christs, and his satans.

And this is that riddle of the Sphinx, that fateful interrogation of the Ages which he has to answer: Will the progressive, still developing brain acquire such knowledge and obtain such mastery and such control over the forces of nature as to "redeem," regenerate, and renew at will the other unprogressive tissues with which brain is yoked in the organism, and which at present condemn it to a brief lifetime with them? Can the progressive tissue redeem and save the unprogressive tissues? We have now good hopes that it can.

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Human Personality

Its Composite and Dissoluble Nature

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HUMAN PERSONALITY.

ITS COMPOSITE AND DISSOLUBLE NATURE.

BIOLOGICAL science places the long-debated problem of human personality under new lights. We are now able to demonstrate how one particular group of cells in the human organism — cells such as were originally, in the earlier ages of the earth, separate unicells — combined, became modified and finally united to form one larger, organized life, in conformity with the law of vital progress, through organization, pointed out in the first paper of this volume. The human brain, indeed, is the grandest terrestrial instance of this symbiotic progress.

It will not be necessary here to enter upon an exposition of the "cell doctrine," or point out that the human body is an organized union of physiological cells, nor iterate the evidences of the evolution of life. It may be taken for granted that readers are familiar with these facts and accept them each in his own way.

We begin, therefore, with the general statement, that the human organism as we inherit it from our ancestors, is an association of cell life, each cell a small organism by

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itself and a descendant, far back, of a protozoon that once lived apart from its fellows and was capable of making its way alone in the world, having matter-moving powers and guided by a lowly intelligence which stood to it as mind.

The present functions of the tissue cell of the animal body, of muscle, bone, cartilage, gland, as we observe them, do not imply a notable individual exercise or display of cell intelligence; such exercise of intelligence is potential in every cell, was once displayed by the ancestry of that cell, and might again be called into use, if the conditions of its environment were altered and demanded it.

In brief, the tissue cell is like an artizan who has so learned his trade and has worked so long in the same factory, making the same kind of goods, that he now works with little mental effort, because it is not required; yet the capacity for other lines of work and thought still survives in him in some degree, although he would very likely starve, or perish, if cast suddenly forth into the wilderness. If the transition from his factory and his habitual food and labor were made gradual, he would adapt himself to the changed conditions. The capacity to do so is latent in him still; — and that is much the status of the tissue cell of the human body as compared with its ancestral unicell of the ancient earth.

We are speaking now of muscle, bone, or gland cells, in short, of any and all of the thirty orders of tissue cells,

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save one. The intelligence of that one has not been as much restricted by its appointed task. We refer, of course, to that order, or genus of cells which appear as brain and spinal cord, or the nervous system as a whole. While the remote ancestry of the neurons was the same as the muscle, bone, or gland cell, its differentiation and training has been distinct; for the neuron has been the cell whose task compelled it to extend its primary quotum of intelligence and develop its lowly wits.

It is with this wonderful group of cells, the neurons, that we have to deal in the vexed question of human personality (personal identity, self-consciousness, "soul"), and incidentally to inquire whether this human personality is detachable from the organism or not. Whether the human intellect can exist and does exist apart from the human body, after the latter is dead, or not.

We are not here understood as affirming that the cells of the nervous system are the only cells of the organism concerned in human personality, not even when this group is extended to include the sympathetic system. Every group of cells in the animal body is faintly and in some minor degree apparent in the sub-conscious human intelligence. All enter into and contribute to that great sea of *feeling* which we term the sub-conscious mind.

Physiologists have even described a sixth sense which they term the muscular sense — the indistinct sensory representation of the vast group of muscle cells in the

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personality. A glance at the organic mechanism is sufficient to show that these cells and groups of cells can have but a secondary, or reflex representation; a faint twice-reflected sense, like earth-shine on the unlighted segment of the moon. For muscle and gland cells form groups by themselves, not interlaced with the neurons and having no interlacing processes, being only reported, if we may use that word in this sense, to the neuron group by means of immensely long filaments which the latter have sent forth. In fact, all those vast groups of cells in muscle, bone, and gland are, so far as the human personality is concerned, but so many outlying, alien provinces of an empire, controlled and stimulated to action from the central capital, but only reflexly and faintly symbiotic with it.

The manner in which personality — intellect and mind — fell to the lot and became the task of the neuron group, is now apparent and can be demonstrated. A trace of it appears even in the zoaria of polyzoa. Something like an incipient nervous system exists in *christatella mucedo* and in *kinetoskias* where a colony of unicells is seen to act as an individual, by transmission of impulses from cell to cell to insure simultaneous action to a certain end on the part of all the cells. The same is observed in the volvocine colonies. This is the first step to a nervous system, — the transmission of a directive impulse from cell to cell.

At this early stage of differentiation of function, any

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cell of the colony may act as a brain or nerve cell. The capacity is inherent in all cells at the outset of multicellular life. The protozoan unicell exhibits functions of muscle, brain, and gland. One cell, living alone, may do all that any multicellular organism can do, on a small scale. But in a colony of unicells — from which multicellular creatures originated — and particularly in a large colony, certain cells, on account of their outer or inner location in the colony, come habitually to do certain things and assume certain functions. Those on the outside unite to propel the colony onward toward food; those on the inside deal with the food after it is seized and ingested; and there come to be those which take it upon themselves to spy food, or to scent it at a distance, in a word, to act as eyes, ears, and nose for the colony.

But to convey what these cells saw, or scented, for the benefit of the colony, to other cells, those for example which propel the colony, it was necessary that certain intermediate cells, or lines of cells, should act as carriers of this intelligence and pass it on from cell to cell, and here we have the origin of a nerve — a line of cells passing intelligence to the other cells, those which propel the colony. In this necessity of the many-celled colony we find the beginning of the function of nerve and, ultimately, of brain. For very soon the need of a common center to which the conveyed intelligence from without could be brought, would make itself felt. Certain cells would be

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impelled by the common want to take up the function of estimating these conveyed impulses, whether faint or intense and imperative, of estimating and responding to them. Thus somewhere along the incipient nerve line a nerve ganglion would be developed from cells which, under other circumstances of the colony's needs, might have become locomotive cells or gland cells. For it is the many common wants of the cell union which have forced the assumption of different functions upon different tracts of cells.

There seems to be nothing very wonderful in the process by which the virgin sensibility of the unicell has been raised to the condition of intellect. We observe, first, a condition in which a cell is compelled to *feel* the *feeling* of another cell. The medium or agency of transmitting feeling in this case is probably an actual current of ions; an "ether," let us say, for the sake of a familiar word. Excited to action by this received sensation, the intermediate cell transmits the sensation to another contiguous cell; this latter in turn transmits it to a third, and so on. But sensation thus conveyed onward, from cell to cell, requires referendum somewhere. Moreover, different lines of cells thus acting as incipient nerves would cross each other, as such lines multiplied, and cause distraction and confusion.

A new necessity arose, the necessity that certain cells along an embryo nerve line, or at the crossings of such lines,

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should assume a higher function of intelligence, the function of determining the relative strength and value of the conveyed impulses which pass through them, and of acting for the common good by judging of them, neutralizing some of the least important, or intensifying others, and, in general, regulating and administering for all. And in these cells at the crossings, or midway the incipient nerve, we find a nerve ganglion developed, that is to say, a little brain for that tract of cells and nerve lines. These cells of ganglia have the magisterial office thrust upon them by the importunity of their fellow cells in the multicellular union. They find themselves the recipients of confided *feeling* from the others, on all sides; they are stimulated by it and led to respond as judges of such feeling. From their situation and the necessity incident to it, the faculty of discrimination and of judgment as to the nature, character and motive of these incoming currents of sensation is in time developed.

The neurons of the brain have thus been made the repositories and agents for the estimation of a thousand simultaneous currents of these partly-interpreted sensations, transmitted to it from all portions of the organism, and particularly from the organs of special sense, the eye, the ear, the olfactory and the gustatory tracts.

Thus impressed into the service of the organism, the neurons have developed in numbers adequate to that service. Instead of a tiny ganglion for the receipt of

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simple sensation, we have in the human brain a grand mass of cells capable of receiving and estimating the perceptions of a hundred inferior ganglia, of comparing these perceptions with other previously recorded perceptions from the same organs of the body and with those from other organs; of deciding as to the relative importance of all these and of responding through the motor system of nerves, in accordance with conclusions which are arrived at after a final estimate of the grand total of perception, reflex perception, and the thousandfold perception of perceptions which make up the complicated process which we commonly call *thinking*.

It is of interest to examine the minute anatomy of the neurons, and study the physiological mechanism by means of which they join themselves together and unite their lives to form the human intellect. Of interest, because this mechanism is the most wonderful thing in the world. Throughout the length and breadth of our earth there is nothing to compare with this sentient combine of brain cells and the marvelous networks of living matter which they put forth to sustain human self-consciousness.

Under the microscope, as we are now able to use it, the entire scheme of the soul's origin and maintenance is displayed. We see and are able to map out the mode of its growth and discern how its manifold virtues, aspirations, instincts, traits, and beliefs have come into existence and stand linked together in a composite whole. Here is re-

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vealed as on a chart the physical basis of psychology — the new scientific psychology of the 20th Century; — and it were better if the old, erratic, creed-attainted treatises were burned, and the site cleared for the truth.

For when free of the taint and bias of religious indoctrination, the new science of the soul can be made so clear, so simple to the understanding, that the average boy or girl of ten will learn it in a few easy lessons.

The means by which the neurons are united in the brain has long been known to minute anatomists; and during the last fifteen years numerous investigators have described the amazing networks which they form in the cortex of the cerebrum. Whether or not the microscopic fibrils coalesce end by end and become continuous from cell to cell, has been a subject of controversy backed by what has seemed evidence on both sides. The contention that the neurons are directly united by their filaments, has not been demonstrated beyond question, the facts going to show that these extended, delicate processes of the cells very closely approach each other and, during the elate, erectile condition of diurnal wakefulness, actually *touch;* and that in sleep this contact is broken, a condition of non-contiguity, brought about in part by the shrinking away of the blood capillary system in the cortex during somnolence.

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Until very recently, however, no observer appears to have fully comprehended the profound psychic significance of this extraordinary web of living fibrils.

Gehuchten, Obersteiner and His called attention to the extraordinary length of the protoplasmic branches of brain cells, and to the extended and intricate networks which they form. Conjecture was attracted to them; but it was not until the growth of our knowledge had embraced other discoveries that these marvelous networks of sentient, protoplasmic threads were identified not only as a means of association of cell with cell, but as the consentient web of living matter by means of which self-consciousness and personal identity exist and are possible. In a word, that it is by means of this vast network of interactive fibers, fibrils and filaments that the many millions of cells of the brain are able to live as one self-conscious entity and give rise to a personal intellect.

Histologically, as the abode of the genus of intellectual cells, the human brain must be conceived of as a vast skein or congeries of nerve fibers, on the outer surface of which, carefully roofed over by the cranium and tough membranes, lie the most important groups of cells.

It is of these cell groups of the convoluted, outer surface or cortex of the brain that we shall here speak almost exclusively, scarcely more than referring to the great nether group or groups, commonly described as the nuclear and fusiform cells; for it is in the cortex that

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the ramifications of the cell processes which we are now to study, are best exemplified.

These cell groups of the cortex, of the cerebrum, and of the superficial gray matter of the cerebellum, are wonderfully well situated for nutrition, supported at ease, so to speak, by the fibrils of servant cells of inferior grade (neuroglia), lodged in fluid beds, and guarded by protective or repair cells. Great advantages are theirs, and great things in the line of intelligence are accomplished by them. Not even our best methods of preparation and staining have yet enabled us to trace all the delicate branches, fibrils and processes which they thrust forth and maintain extended, in order to touch and to lie in sentient contact with those of other cells, thus enabling hundreds of them to live in close perception and sentient communion one with another.

The cells of this class, or species, from the human cerebellum, or lesser brain, differ considerably in size and general appearance, from those of the cerebrum, and also from those of the spinal cord; but from their position and connections, their psychic role is believed to be similar, since they are held to preside over and inaugurate the passage of subjective sentience into molecular motion.

The protoplasmic processes of the large Purkinje cells from the folia of the human cerebellum interlace somewhat as sketched with a pen in the accompanying drawing. But neither in this sketch, nor the merely diagramatic one

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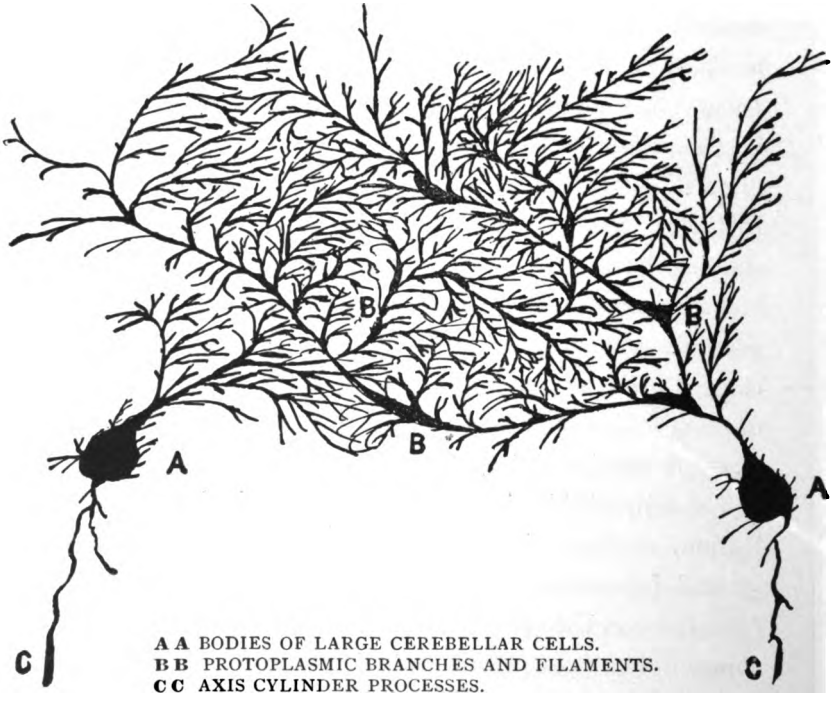
of pyramidal cells from the cortex cerebri, which follows it, can the amazing networks which the branches and filaments form, be fully depicted, since as seen on "slides,"



A A BODIES OF LARGE CEREBELLAR CELLS.
B B PROTOPLASMIC BRANCHES AND FILAMENTS.
C C AXIS CYLINDER PROCESSES.

after microtome section, the filaments are often broken, or cut asunder.

The Purkinje cells, so called, are from .03 to .04 of a millimeter in length; but the branched processes and fibers which emanate from them are of far greater extent.

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These cells are collocated in a layer at a depth of less than a millimeter in the outer stratum of the foliated cerebellar surface, and are nourished from a rich capillary plexus. They are supported, that is to say, held up otherwise than by their own consistency and firmness, by a system of adjuvant cells called neuroglia and formerly known as "spider cells," or "basket cells," which some observers have been inclined to classify as semi-nerve cells. In some tracts of the brain these spider or basket cells have been discerned as forming a net of supporting fibers about the body of the larger nerve cell.

From what may be designated as the base of the nerve cell, there emerges a process, or protoplasmic branch, termed the "axis-cylinder process," which dips downward into a layer of smaller nuclear cells and enters the great skein of nerve fibers which forms the central parts of the brain. How far this axis-cylinder process or fiber proceeds has never yet been fully demonstrated, but it is believed to proceed to, or become continuous with a fiber which does proceed to, other tracts of the opposite hemisphere of the brain, and even to pass down the spinal cord and extend to distant tissues of the body.

Reverting again to the body of the cell, we find issuing from the other side, the side opposite the base and hence the part directed toward the outer surface, one and frequently two large branching processes, which often extend a relatively great distance toward the extreme outer sur-

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face of the cortex and branch, like a tree top, into smaller and smaller processes and fibrils, till the best methods of preparation fail to trace them farther.

In this outer layer of the cortex of the cerebellum (which has been inappropriately termed the *molecular* layer), the extended, constantly branching processes of many cells lie side by side, contiguous, and in contact; and as these processes and fibrils are protoplasmic and sentient, we can scarcely doubt that they *perceive* each other from such contact, and communicate one with another. In a word, there is the strongest probability, short of certainty, that the business of *willing* movement outward to the muscles is dependent upon the concerted action of these cells.

Besides the fibrils of the large Purkinje cells there are also in this outer "molecular" layer, minute fibrillar processes from great numbers of smaller cells which lie embedded in it; also nervous fibrils which, so far as discovered, are not processes of cells, but seem to be of the nature of separate growths, analagous in some degree to the fibers of muscular tissue, which are not pure protoplasm but of the nature of protoplasmic alloys.

These latter minute fibers also lie in contact with the diffused fibrils of the Purkinje cells, and apparently bear sentient impulses from them downward into the vast hank of central fibers.

Beneath this layer of large-branched cells, there is another class or variety of smaller nuclear cells, the bodies

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of which have scarcely one-fourth the diameter of their superior neighbors. Many of these have small fibrillar processes, one of which is sometimes seen to rise toward the "molecular" layer, while the other dips downward amidst the white *fasces* of fibers. The function of these smaller nuclear cells is not easily divined.

In the medulla oblongata and in the gray columns of the spinal cord are also found large cells with branched protoplasmic processes, somewhat resembling those of the cerebellum, with small nuclear cells and fusiform or spindle-shaped cells, in connection with the same mazy hanks and bundles of communicating fibers. And in the great hemispheres of the cerebrum, or grander brain, is found an arrangement of superior cells and inferior cells, with enormous hanks of fibers similar to that observed in the cerebellum, but on a vaster scale.

The superior and larger cells of the cerebral cortex differ in form from the Purkinje cells, and from their triangular outline have received the name of pyramidal cells. They are found in great numbers and at varying depths in the "molecular" gray cortex of the cerebrum. The body of a large pyramidal cell averages about .04 mm. in length by .02 mm. in width. It occupies a free space, is surrounded by blood capillaries which supply it with nutriment, and rests easily in lymph fluid, with a number of protective cells and repair cells in close attendance upon it. It is further supported by the nets of

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"basket" cells (neuroglia), and altogether is placed in a position of ease, as if for intellectual labor. The large cell body contains granular protoplasm; and within it are to be seen the essential cell nucleus, occasional vacuoles, and very frequently a few grains of pigment. The base of a pyramidal cell is directed toward the axis of the brain convolution, *i. e.*, toward the mass of white medulated nerve fibers of the interior. At the base, the protoplasmic cell-substance is prolonged downward in a number of branched filamentous processes; and ordinarily, about midway, one of these assumes the character of an axis-cylinder process, which, entering the mass of sheathed fibers, becomes one of them, extending eventually to some distant quarter of the brain or of the body. The other processes from the base, especially those from the outer corners, branch out in finer fibrils, which intermingle with those of other cells and with the minute fibers which certain cells appear to produce and cast forth from their cell bodies.

A still more remarkable process, however, rises from the apex or top of the cell. This apical process is directed upward or outward into the cortex, branching at intervals and extending to a comparatively great height into the "molecular" or outer layer of the cortex, where its fibrils lie in contact with those of numerous other cells.

In certain situations, noticeably at the summit of the convolutions, some of the pyramidal cells attain great size,

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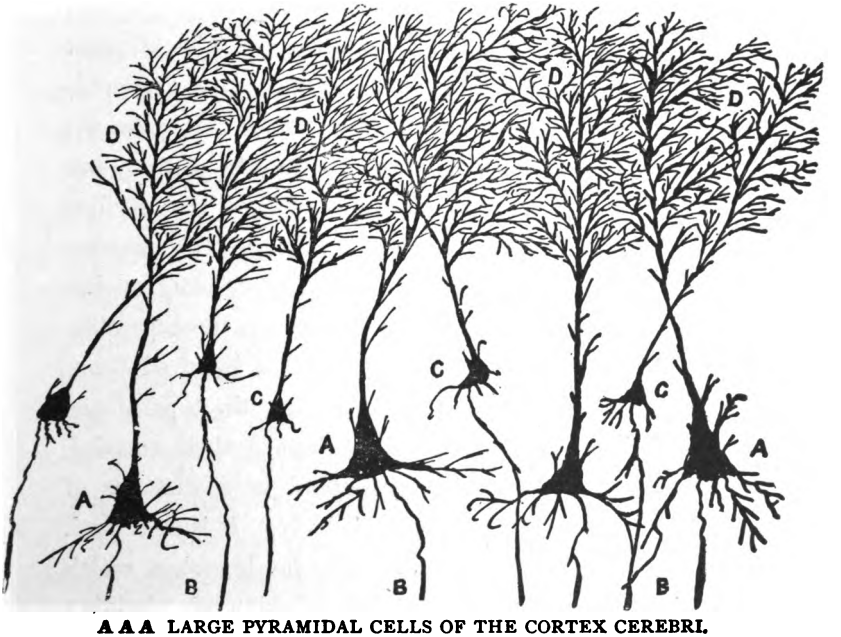
comparatively, and are found to have bodies .12 mm. in length by .05 mm. in width; but, in far greater numbers, there is associated with them a class of small pyramidal cells, much like those described above as regards form and processes, but smaller, having bodies no more than .01



AAA LARGE PYRAMIDAL CELLS OF THE CORTEX CEREBRI.
CCC SMALL PYRAMIDAL CELLS.
BBB AXIS CYLINDER PROCESSES.
DDD APICAL PROCESSES AND PROTOPLASMIC BRANCHINGS.

mm. in length by .005 mm. in width. It is not impossible that these small pyramidal cells are a reserve in slow process of development to the larger class, or would so develop under stimulus.

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Beneath the layer of pyramidal cells there is also found in the cerebral cortex a "nuclear" layer of small rounded cells, some of which have protoplasmic processes as seen in the cerebellum; and there is also a fusiform group.

We find that the entire surface of the cortex cerebri is composed mainly of these marvelous networks, associated with the plexuses of blood capillaries and the adjuvant neuroglia required for their physical support and maintenance. The superficies of the cortex, indeed, is by far the most remarkable structure of which minute anatomy has knowledge. The extent and intricacy of the fibrillar threads, loops, and twigs, formed by the mutual interlacing and interlooping of the thousands of tree-like branches which the cells send upward into it, are quite incomparable. In this respect the cortex of the brain is a hundred times more dense and more involved than are the tops of the trees in a dense forest. The branches, in their amazing ramifications, not unfrequently extend to a distance of twenty times the length of the cell body. It is as if each tree of a thick forest sent forth vines for branches, which climbed to a distance of several hundred yards, dividing as they proceeded into a thousand vinelets and tendrils, which enwrapped and entwined everything in their course. Such a jungle, growing to a height of several hundred feet, would no more than illustrate this astonishing lacework of the protoplasmic fibrils of the cortical cells.

Histologists were early led to inquire with wonder as to

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the significance and use of this mazy output of living filaments.

It cannot be wholly or largely for the purpose of accomplishing cell nutrition, for these cells are nourished by the saprophytic or absorptive method, and not by the prehension of food particles.

It is not to accomplish locomotion, for these cells rest nearly stationary in fluid beds, sustained by the nets of neuroglia.

The conclusion is reached, of necessity, that these far-branching processes are thrust forth for the purpose of mutual perception and communication, cell with cell. The sentient, protoplasmic fibrils touch, or so nearly touch that what one cell feels and knows is known and felt by its neighbor cell. It would follow that an impulse or a sensation which comes to one through its afferent fiber from the outer world is felt and known by all its mates throughout that entire convolution or tract of cells, and not only in that one convolution, but — so complete is the protoplasmic connection — throughout the whole brain, which is thus made to take cognizance of sensation as a unit, as a personal, self-conscious individual.

For all this mazy web is demonstrated by the reactive agents of our staining fluids to be pure protoplasm ; sentient, living matter, capable of feeling, and able to convey sensation. When, therefore, a sensation, received either through the eye, the ear, the organs of taste and smell, or

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through the thousand sensory nerves extending to the surfaces of the body, is transmitted along a sheathed nerve fiber and reaches one or more of these large cells of the cortex, intelligence of such a sensation is at once distributed by means of the sentient network to a hundred neighbor cells, and from them is diffused over the entire brain, which thus receives tidings as if it were a single huge cell, instead of an aggregation of two hundred millions of cells, each a distinct living creature.

By means of this sentient bond of cell to cell, afforded by the protoplasmic networks, many millions of cell lives are blended in one common life, having one common sense. By means of this bond, too, a higher life of greater compass than that of the single cell is rendered possible. For by it thought, which is the business of comparing what one cell or tract of cells knows with what another cell knows, begins, and both cells are thereby made wiser in experience. Reason is set up; imagination is made possible; and, in the end, the human intellect is developed from what was at first the primary sentience of individual cells.

For it is not here intended to advance the doctrine that the human intellect is of no higher character than the sentience of a brain cell. By means of this extended organization of cells, too, something more than a quantitative and cumulative result is attained. Human intelligence differs, not only in quantity but in degree, from

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cell intelligence. By specialization and organization, a higher plane of intelligence is reached. Biological synthesis would lead us to infer that by means of organization, higher and higher planes of sentience and intelligence have been successively attained — a long series of such ascending steps — since first the simple elements of life began to seek expression in terrestrial matter. Extended organization and the specialization of parts to distinct uses have led to those more complicated actions and reactions in the plastic, protoplasmic substance, the entirety of which issue in a higher kind of intelligience; higher because vastly more of form and of experience is included in the brain as a whole than in the cell.

Briefly, we wish to convey the idea that, according to the present biological conception, the human intellect is something more than the associated sentiences of the two hundred millions, or more, of cells contained in the brain; that it is an extended development of those sentiences to a higher grade of intelligence, rendered possible by the interaction and intercommunication of the cells.

This association and this organization have been largely due to the wealth of protoplasmic branches and fibrils which the brain cells have thrown out, in order to come into touch and sentient contact with each other. Once touching, by whatever agency contact is brought about, something of the nature of "current" from cell to cell throughout the whole brain appears to be set up and

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maintained at a considerable tension during self-consciousness, *i. e.*, during wakefulness. To generate current for maintaining the consentience of the brain as a whole, an increased blood supply is requisite; work is done and energy absorbed. The condition, moreover, gives rise to waste products and leads to exhaustion of the cell, rendering a period of recuperation and rest necessary. The consentient circuit must needs be broken. In sleep, the brain cell ceases to live in its corporate or social capacity and reverts to its old-time, unicellular mode of life. Independent again, it nourishes itself and gains strength and substance afresh.

Wonderful as are the protoplasmic processes which the neurons put forth, to secure consentience throughout the brain, they are not without their analogue in unicellular life. *Amœba radiosa* projects long linear rays, as it floats, to enable it to perceive and draw in food particles. *Gromia terricola* projects a net of filamentous rays and snares. *Raphidiophrys elegans* emits long, lance-like rays, or darts of exceeding tenuity, more minute than the finest fiber of silk. In the case of unicells these filaments are temporary, befitting the wants and necessities of single cell life. In the case of the neurons the necessity is for filaments continuously extended.

Revert for a moment and grasp the underlying principle of this vast development of the human personality by the neurons. *Ab initio*, it founds on that

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esoteric property, or primal ingredient, of living matter by virtue of which the sentient ions combine in the "atom," the atoms in the self-mobile molecule of protoplasm. For that great mystery, matter, is not a dead fabric, but an ever-living, sentient, self-moving substance. Out of this ever-living substance the physiological cell, as we find it in the human organism, has developed by a complexity of evolution which, if we could see it microscopically unfolded, would rival even that congeries of interlacing neurons in the human cerebrum. Yet we now make this neuron the unit of brain architecture. The infinitesimally minute fibrils by which ion established sentient relationship with ion, to form protoplasmic molecules and set up the personality of a cell, are invisible, as yet, merely a matter of conjecture. But the wonderful mechanism of filaments by means of which the brain cells establish sentient contact to form the human personality, is now visible.

By means of this elate, retractile mechanism, this vast network of *feelers*, each cell of the brain is able to *pool* its self-life in the grand merger of brain life, but resumes that self-life again when, by shrinkage or retraction of the network of filaments, sentient contact with other cells is broken. From such sentient contact, thus induced and brought about, the larger personality ensues. Yet we merely see here on a large scale with millions of cells, what occurs when two, or three, or a hundred unicells

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join and set up a communal life. By sentient contact with each other a new, larger personality comes into existence, as if around a new axis of consciousness. Several cell lives are thrown into one. The *ionic* relationship, or reciprocity, suddenly, instantaneously changes. A new sentient polarity is struck; as if earth and moon came in contact and a new center of gravity were set up in the contiguous masses.

Personality is not resident in any one prominent neuron, or monarch cell, but in all the cells, consentient together. There is no "king cell" ruling the others, in which personal identity centers, no sovereign "monad." This view had its day and has been wholly discredited. No more is the human intellect located at any one portion or particular tract of the brain, as for example, the *corpus striatum;* this notion, too, had its day and passed to the limbo of similar contentions, made before the consentience of the neurons was understood. Personality is a coherent blende of the lives of all the neurons, dissoluble and terminable in sleep, or from shock, or at death of the organism.

This faculty or ability of the cell to unite its life with other cells, surrendering that life to become, for the time, part of a life greater than its own, has never received much recognition, as yet. None the less, it is the keynote of human personality; and no adequate conception of that personality, or soul, can be formed until it is comprehended.

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In truth, it is time to cease speaking of the human intellect as a psychic integer, an indissoluble unit of intelligence. Never was there a doctrine more at variance with the facts, or founding in greater ignorance of the human brain.

A Society for Psychical Research which bases its investigations on the assumption of a detachable *psyche*, goes wrong at the outset, and from the very nature of things will wander in darkness and meet with little success in its quest.

Human personality can now be resolved into its separate cell sentiences, each a cell personality. We are able to show how the cells (neurons) unite, by what means the greater personality (soul) is brought into being and maintained from moment to moment and from year to year, and also what physical steps and events are associated with either the temporary, or the eternal cessation of that personality. There is no longer excuse for ignoring these facts, or for teaching or assuming that self-consciousness is an infrangible unit, that lives "unscathed amidst the crash of worlds, untouched by the death of matter itself." Such "long bow" may do for sermons to hopelessly indoctrined sectaries, but has no place in modern physiology. Not "the crash of worlds," merely the impact of a cobble on the human cranium will cause the sentient neurons to retract their interlaced filaments, for a few moments it may be, or for hours, or forever. Self-

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consciousness ceases until they resume contact. If the blow was heavy, it is never resumed.

So ephemeral a thing is this self-conscious personality, this soul of man. And at best it is intermittent, with the alternate lighting and darkening of the terrestrial hemispheres. Once in twelve hours it must stop in order that the neurons may rest from the stress caused by their unification as mind. The self-conscious personality is as much lost in sound sleep, as in organic death, only in the one case sentient contact is resumed, in the other not.

Moreover, this personality varies in degree according as the brain cells come fully into sentient relationship, or but partially. In certain degrees of somnolence, a part of the brain cells appear to join contact, giving rise to dreams. A dream implies a minor degree of self-consciousness; a part of the neurons are in contact; but the more complete personality of waking hours is not established. To be fully self-conscious, all the lobes, convolutions, and tracts of cells must be involved. This is best accomplished after the cells have rested, after sleep, when each cell has for a time been withdrawn from the consentient *bund* and has had time to attend to its personal wants, nutrition and the expulsion of waste products which accumulate while the cells are consecrating their energies and merging their self-lives in the greater life of the organism. The sentient contact is less perfect toward the end of the day, when the neurons are fatigued. The personality

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is then much affected. We grow heedless and do work badly; the *morale* runs down to lower degrees; we are less hopeful, less ambitious, and yield more readily to temptation to evil courses; and this because the personality is weakened from less perfect sentient contact of the cells.

If the brain of the criminal classes could be inspected and examined with this end in view, it would be found below normal in these particulars of the formation and maintenance of the personality.

When one hemisphere of the brain is damaged, or paralyzed by pressure of clots from ruptured blood vessels, so that cerebration is limited mainly to the other hemisphere, we have the phenomena of a diminished personality, an intellect abated in volume and power. The axis of self-consciousness appears to have shifted. Personal identity continues; yet the patient remarks *that he is a little strange to himself*, and has the feeling that he is not quite the same. To his friends it is evident that he is not what he was before the seizure.

In extreme old age, when the progressive enfeeblement of the neurons has become marked, at ninety or a hundred years, the personality dwindles to so feeble a flicker as scarcely to enable the person to be self-recognizant, or perform the most habitual acts. It can hardly be termed personality, since there are constantly recurrent lapses to self-forgetfulness. *Pari passu* with the cell exhaustion, personality slackens and deliquesces to the vanishing point,

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giving that surest of physiological evidence that intellect has its source in the cells, shines forth from them, and disappears as these founts of life grow dry.

From out the well-nigh infinite atomicity of matter, swift tides of ions, or electrons flash and flow through the combined mass of the neurons; and it is conjectured that this etheric medium forms the base of mentation. This is not yet science, but surmise, not yet demonstrable. There is reason to theorize, however, as to such a "spiritual body" within the "natural body" of the human organism; a subliminal emanation or etheric eddy in which the neurons and other cells lie saturated or surcharged. There are many evidences, physical, electro-magnetic, actinic, that go to render the surmise a probable one. It falls in line with what we know otherwise of the marvelous attenuation of matter, its fluidity and almost inconceivably rapid motions. Something of this sort must exist, just what it is biological science does not yet undertake to prove; whether the residual ions and electrons of the universe form the "luminiferous ether" of the older physicists; or whether, as is most probable, there are particles of lesser mass, having far more subtle and approximately instantaneous motions; a descending series of such particles dropping into profound depths of atomicity which the human plummet has not yet sounded, and where science, perhaps, never will find bottom. For matter is the one great mystery of the universe.

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It is in the amazing flux of these tides of etheric matter, that all "spirit" phenomena, past and present, found and hold their place in popular credulity. The point always lost sight of by priest and devotee, charlatan and dupe, alike, is that it is only by virtue of long-perfected organization that a "soul" is raised up to self-consciousness; that the human personality requires and presupposes an organized brain which only the entire evolution of the human race has brought into existence; that intellect and mind result from organized union of the millions of neurons which form the brain and nervous system; that personal identity exists only by virtue of the coalition of these cells, and no longer than they coalesce; that self-consciousness depends on that perfected mechanism of sentient filaments by means of which the neurons pool their self-lives to become consentient; and that when this mechanism of union is impaired or destroyed, personality ceases, being resolved first to the inferior intelligences of the cells and ultimately to the lowly sentience of elementary matter — when the cells themselves die and are reduced to their component molecules and atoms.

It is this point of the long-descended organization of living matter, which the biologist has ever to keep in mind; for if our science teaches one truth more conclusively than another it is that intellect and mind are never seen to exist in the absence of a delicately organized union of cells.

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At the present stage of popular credulity concerning disembodied spirit-life, the ground is taken by many, many even who lay pretention to scientific attainments, that as ion and electron appear to possess a pyschic property they may be aggregated in a "spiritual body" which is liberated at the death of the organism, to fly, or float away, still continent, with personal faculties intact; that this subliminal self coheres and remains individual; that it still sees without eyes, hears without ears, smells without olfactory tract, and tastes without gustatory follicles; that it still reasons without the interlaced pyramidals and moves without sensory ganglia and motor nerve fibers.

According to this loose conception, indeed, the physical apparatus is really not at all necessary, being a kind of superimposed clog on "soul life" which sojourns in the animal organism rather than forms an essential inseparable component of it, the point being that at death, it somehow frees itself, gets away, and preserves the much desiderated self-consciousness.

The argument is never very clear as to ways and means but takes such jumps as are necessary to gain the object sought. And grave professors of psychology announce with dignified aplomb, that they "see nothing inconsistent in this view."

What volumes do such naive admissions speak for the present dense ignorance of this same self-exalted psychology! What utter lack of comprehension of the

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first principles on which nature acts for the production of the human personality!

The human soul is not a nebula of confluent ions, not an undeveloped gas of sentient atoms, not the raw diffused base of sentience, but a fabric long developed from this sentient base. Ion has combined with ion, "atom" with "atom," and molecule with molecule in long-perfected, orderly union to give utterance to the lowly intelligence of the cell — the protozoon. That lowly intelligence is the cell's soul. It exists in such degree and at such a height of intelligence only by virtue of an intricate arrangement of its component molecules and reciprocal action between them. To give utterance to the cell soul the sentient particles of which cell and nucleus are composed have to bear certain relations to each other, occupy certain positions one to another, and exert on each other a series of impulses, to and fro, direct and reflex. Moreover, they have to preserve these relations and keep these positions one to another, in order that the personal identity of the cell may be preserved from hour to hour and day to day. The cell soul depends on the stability of this *form* — to use the word in a German sense. There is a progressive development of the sentient substance to something which is reciprocally very mazy and complex, before we get the cell soul; and while that cell soul continues to exist, the *form* must be preserved intact.

Crush the cell, scatter those sentient ions, atoms, and

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molecules, and you have indubitably lost your cell soul; it has sunk back to the basic sentience of universal matter. That the ghost of it goes floating about the universe is contrary to everything we know of nature; for nature produces degrees of intelligence only by complex combinations.

The human organism differs from the cell only in being larger and more varied; since it is composed of cells organized, cooperative, and consentient. In a general way, the human organism is to the cell what the city or the nation is to the individual citizen. In the organism we have a more voluminous life than that of the cell, but life of the same character and quality. The cell is an epitome of the human body, the body an organized multiple of the cell; the cell sentience is the essential unit of the human life, and, indeed, of all terrestrial life. A human life is, therefore, the consentient product of the cell lives of which the organism is made up.

In the course of these long organizations of cell life, sense organs and apparatuses have developed which put the consentient colony or mass of brain cells in wide, extended communication with the external world, in touch largely with the universe, with the result that this personalized mass of living matter becomes the recipient and repository of sensations and impressions of all sorts from all quarters. In a word, it is made the repository of *knowledge*, and while thus receiving and recording, be-

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comes what we term educated, cultivated, refined, by a continuous process from infancy to old age.

The cells of the brain not only interlace, but act reciprocally one to another and reflexly, setting up a well-nigh inconceivably delicate *form* which remains *in situ* during the individual life, or is but slowly modified by fresh accessions of knowledge from without. Each cell neuron of the colony-blende is thus enabled to profit by the experience of the whole and is *formed*, moulded, modified by the greater life and attainments of the whole organism.

High degrees of intelligence are thus reached, the intellects of great thinkers, our Darwins, Weissmanns, Huxleys, Haeckels, Gladstones, Spencers. In each we have an inherited mass or colony of neurons of exceptionally good quality and then, personally, a continuous development which, could it be displayed microscopically, would exhibit organization of such delicacy and complex arrangement, and yet such permanence through life, as would go far to set psychology on a new basis, and prove nothing less than a revelation of Nature's method of producing a human soul!

Upon this whole delicate organization and upon nothing less, personality depends from moment to moment, and from year to year. It is only by virtue of this mazy organization of living matter that intellect exists or can go on existing.

What happens at death?

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First, the interlacing neurons let go their hold on each other — and self-consciousness of the person vanishes. It goes out, as flame vanishes when atoms of carbon and oxygen no longer combine.

What next?

The heart no longer propels the life tide of refined food in the blood to the brain — as in sleep — and after a few minutes the neurons themselves die from suffocation and starvation. All those thousands of little individual lives vanish, as did the larger self-consciousness of the person; for in each the consentient bond of living molecules, atoms, and ions is disrupted.

What next?

The dissipation of the brain as cadaver is a somewhat slower, more heterogeneous process, involving invasions of bacteria, disintegration, and reduction to more stable compounds, but tending ultimately to a return from the highly complex living substance, with all its maze of organization, to the abysmal base of the primeval ions and their lowly endowment of life-potential.

What was once the soul has been resolved back to this elemental life-potential of unorganized, unconditioned matter. To think of it or represent it as self-conscious is to deny the first principles of Nature. Human self-consciousness is the long-derived result of evolution by organization of cell life. Intellect is the outcome of a million years of brain. The human soul is the flower of

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terrestrial life, and at present, alas, almost as evanescent as a flower. What the scientific world has most need to apprehend is *the principle by which Nature works to form a soul.*

The theological penchant for conceiving of the soul as an irrefrangible unit or entity, leads constantly to erroneous conclusions concerning it and concerning its fate after the death of the organism. Even introspection shows us that self-consciousness is but a play of the primary sentience of matter over an organized fabric of brain; that we are intelligent as far as the experience of life has impressed itself on that brain fabric and no farther; that obliterate this recorded experience of life, ancestral and personally acquired, and naught remains to us of personality; naught save impersonal *feeling.* Individuality, personality, soul, comes only after an axis of self-consciousness has been set up in living matter; it grows up about such a life-axis by virtue of organization of the living substance. Under certain favorable conditions the low-sentient property of unorganized matter appears able to inaugurate unicellular life.

The conception of an unorganized "spirit" personality afloat in space, coming and going, formed and unformed from time to time, is an anomally which presents itself with growing absurdity as one's knowledge of Nature increases.

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In the case of a colony of unicells, combining for a common life, the resultant consensus of cell lives is a simple one, differing little, save in volume, from that of any one of the component cells. In the human personality — not differing in principle — we have the consensus of cell lives extensively developed. The cells of the optical tract, for example, are stored with scenic impressions that come to them through the apparatus of the eye; yet do these stand connected, sentient and perceptive, with every other cell of the brain, and flash to each their pictures of the external world. In like manner the cells of the auditory, olfactory, and gustatory tracts transmit to the entire aggregate of cells with which they are in touch, sensations of sounds, flavors, and odors of which they are the recipients. From the sympathetic system, from the heart, the lungs, and the other organic apparatuses, as also from the peripheral nerve cells, come constant tides of sensation which impress every cell in the brain. So extended and perfect is the mechanism of contact that each distinct impression from the external world, or from the different organs of the body, is flashed to, and pervades the whole unified group of neurons. In greater or less degree they all take part, although the organized division of labor has delegated to the motor neurons the function of response.

To trace the education of brain and describe the development of intellect from the interaction between the sentient fabric of cells within the cranium, and the external

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world, would exceed the purpose of this paper. The picture presented is one of manifold sensation, impression, record and adaptive growth, from birth to adult life. The coherent mass of neurons stands all-cognizant about a common axis of self-consciousness; for sentience like the other attributes of universal matter, displays polarity. A more detailed account of how personality develops, grows to its zenith prime, and wanes in "old age" toward the dark nadir of extinction, is reserved for the future.

In extreme "old age" there is in truth little left of the "soul" to save, either by divine intervention, or human achievement. Personality has indeed become but a "shade" of its former self, a feeble, lambent corpse-light, flickering to its cessation. It is the cell-neurons which need a reincarnation; personality would then up-brighten again as when oil is renewed in a burned-out lamp.

The cell-neurons of the great highly developed brain-colony will continue to shrink in senescence and lose the power to maintain personality, until such time as we discover how to regenerate them *in situ*. Such is the present human situation. Is it not better to face this situation bravely, and start afresh in our quest for immortal life on the firm ground of natural salvation?

And are we really worthy of immortal life, would it be best for us, until we can achieve it for ourselves?

Nor is the achievement superhuman. In the next annual edition of this publication (1906) we shall attempt

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to point out what has to be done to regenerate the physiological cell, and along what lines research must be pushed to this end.

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The Intimate Causes of Old Age and Organic Death

Examined with a view to their alleviation and ultimate removal

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THE INTIMATE CAUSES OF OLD AGE AND ORGANIC DEATH.

EXAMINED WITH A VIEW TO THEIR ALLEVIATION AND ULTIMATE REMOVAL.

CLASSIC fable records the catastrophe of the Earth-born who, rashly importunate, strove to scale Heaven; and Hindu sages have taught that the Lords of Life and Death have jealously delimited their realms and shut the doors, lest mortals pass the forbidden thresholds; that in the present orbited order of matter and the cosmos, death must follow fast on life, till the order ends; till orbital motion unlooses its swift arcs and the bright, huge-grown orbs rarify in the fire-dust of another universal nebula. Not till then may the Lords of Life and Death loose our mortal bonds.

Yet even in most ancient days there lived a Prometheus, an Æsculapius, an Epicurus.

"Him neither fear of the Gods, nor thunder-bolts, intimidated, nor portents in the skies, but rather roused the innate courage of his soul, that he should be the first to break down the jealously guarded portals."

What man has dared, man will dare again and more.

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"The bold breed of Iapetus presses on, unabashed, with face set to the dangers of an unknown future." Across the gulf of more than two millenniums, the hardy courage, the bold initiative, of these great-hearted ones of old, lends inspiration. The breed survives, the breed that brought down fire from the emperean, that raised the dead.

That is ever the scientific spirit, the spirit that came from partaking of the Tree of Knowledge, the spirit that will accept nothing less than an untrammeled liberty to seek knowledge and use it.

To-day, in these opening years of the 20th century, we face the greatest, the gravest problem which has ever engaged the attention of men, the problem of controlling and prolonging our lives at will.

Medicine, all medical practice, is an effort to prolong life, or postpone the immediate dissolution of the human body. From the 13th to the 18th centuries, too, while chemistry was still nascent, there were mystic alchemists and alleged Rosicrucians who sought to grasp a sporadic immortality by elixirs and strange decoctions. But not until this last quarter of a century has the grander idea been grasped, that prolonged life, looking toward immortal life, will be the natural outcome of the evolution of life on the earth.

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It was an idea that could hardly have found place until the *Origin* of *Species* and the *Descent* of *Man* were written, since it is the logical complement, the sequence of these doctrines of nature. It could hardly have come before, save, perhaps, as visional in the brain of a philosopher. But following the epoch of Darwin, Huxley, and Tyndall in England; of Humboldt, Goethe, Helmholtz, Haeckel, Weissmann in Germany, and their biological contemporaries in France, America, and other lands, the achievement of immortal life follows as the keystone of the arch, the climax, the perfected fruit and flower of the evolution of life on the earth. Follows from the natural growth of knowledge in the human brain, presenting itself in the light of a great achievement. For, with the dawn of this new century, we have wakened to the hard fact that whatever we have here on the earth we must achieve for ourselves.

More life, longer, happier, personal life, idealized as immortal life, has been the dream of all the human ages. It is the voice of nature — nature that everywhere makes oath that to live is better than to die; and that life even under hard conditions is worth preserving. This is the "instinct" of the cell-of-life, both as a protozoon and when united and organized in the metazoon; it is the voice of the cell, heard crying up from its lowly depths in the tissues of the organism. It is the faith of the subconscious life in us,

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Ever since neolithic days there are evidences that human beings have regarded death with repugnance and fear and have made rude efforts looking to salvation. The primitive religious cults all breathed this grief at death, this desire for more life.

But for the last ten thousand years human beings generally have despaired of escape from death by self-effort, and made their appeal for salvation to supernatural powers. In their ignorance of nature and the causes of natural phenomena, a vagrant belief in disembodied spirit life took form: the "shadow," the shade, the *psyche*, the *umbra*, the *manes*, the wraith, the ghost.

Full of doubt and of fear as the belief was, it yet proved a species of solace, solace for the hard fate of individual life. The hope of more life has never been given up, never can be given up, since otherwise life would not be life; but as death appeared inevitable, our far human ancestors comforted themselves with this quasi belief in "soul" life after death. The comfort was always hazy; the hope had always to struggle against common sense, and faith was ever infirm; yet, after a manner, the sick and dying found a nebulous solace in it; death was a little easier.

Sacerdos entered, put on his robe and took charge of the vagrant belief in ghost life. What had been merely a fitful belief was exploited in a creed, with doctrines. Rite and ritual were prescribed, sacrifices enjoined, and

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tithes collected. Reason and conscience were borne down by the voice of sacerdotal authority, nether worlds for torture were invented, and blind faith exacted under ban and penalty. Fane, shrine, temple, mosque, and cathedral were reared, and vast guilds of insolent priesthood organized. "Religion reared her proud head in the skies; human life groveled foully in the dust."

That was the price, the penalty, which humanity paid for longing after more life, for believing that somehow there would be immortal life somewheres. We should fix our attention, not on the errata of creed and religion, but on the nature of this great Hope of the human heart, the Hope that inspired it all.

For, if human beings had all along been persuaded with certainty that this earthly life of three score and ten years were all to which they could attain, there would have been no religion, no priest. It was the longing for more life which made religion possible in human history.

Sacerdos proved the greatest of hypnotists. Humanity passed into the sleep of the creeds, the long-night incubus of faith in the supernatural, with its phantasmagoria of gods and devils, nether-worlds and upper-worlds, limboes, purgatories, torture-hells, and gaudy-golden heavens!

A long, wild, troubled night of the human brain.

Ten thousand years of supernatural religion.

It is from this nightmare of indoctrination, this trance of dogmatism, this long-woven spell of sacerdotal authority,

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that we are now waking, waking in the clearer light of our growing knowledge of nature.

Passing over the old-time theories and beliefs as to old age and death — beliefs connected with the religions — it will be worth while first to make a resumé of existent knowledge and views on the subject.

So few persons actually die of "old age," it has often been denied that such cause of death really exists. More than seventy per cent. of all deaths is from acute or chronic invasions of the disease producing bacteria, either sudden, sharp attacks, or prolonged sieges. From birth to advanced age, the human organism is continuously invaded, assaulted, and preyed upon by noxious unicellular life.

In time, these multiplied assaults, and the damage resultant from them, inaugurate very complex, far-reaching complications, difficult to trace and estimate. For an organ, or tissue, enfeebled by microbic attacks, gives forth an altered, inferior product which in turn embarrasses and lowers the vital tone of other organs and tissues. Thus the entire organism is progressively impaired and depressed from normal function. In this condition it is less resistant to the never-ceasing attack from without; for a high vital tonicity is the organism's natural defence. As years pass it becomes impossible to calculate from cause to effect the damage done by bacteria. We are able only to draw a

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general conclusion that the vital coefficient of the organic life, which in theory should be biostatic, is thus slowly diminished to a point where the personal life succumbs to almost any fresh attack from without, or new insurrection within. For certain disease germs become intrenched in the tissues, so to speak, and there bide their time to deliver further assaults, and go on forays up and down the blood circulatory. Moreover, the roaming white cells or corpuscles of the blood sometimes assume the role of intra-organic assailants; — and this brings us to consider one of the latest theories of old-aging, that of Prof. Elie Metchnikoff, of the French Institute, namely, that after middle age, these leucocytes, now known as phagocytes, begin to prey on the more highly differentiated cells of the stable tissues, bone, muscle, skin, etc., and even on the neurons of the brain and cord, to the extent that a gradual wasting away ensues, with the consequent phenomena of old age.

Professor Metchnikoff distinguishes two classes of phagocytes, the macrophages and microphages, the latter smaller than the former, having extensible nuclei which permit them to pass freely through all the tissues. It is to the more voracious macrophages, however, which are essentially minute animals, that the damage to the organic tissues in advanced life is chiefly due: they turn cannibals, so to speak, and devour the cells of the associated tissues; and the cause of this unnatural perversion of appetite, or morale, is attributed to poisons of the nature of ptomaines,

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produced by several orders of putrefactive bacteria which, as life advances, find lodgment all along the alimentary tract, becoming "naturalized" there in immense numbers.

Professor Metchnikoff sees reason to hope that these invasions of putrefactive bacteria may be combatted by ingestion of the *kefir* microbe, found in specially soured milk, and himself makes use of it. He also believes that the cells of all the tissues may be "reinforced" by substances of the nature of *serums*, obtained by the now familiar methods of inoculation of the horse and other animals.

As a result of all his studies and discoveries, Professor Metchnikoff announces his belief that the present "span of human life" may be prolonged by from sixty to eighty years; that the healthy working period of middle age may extend considerably past a century, thus placing himself in harmony with Buffon, who believed that the natural lifetime of man was not less than one hundred and twenty years. Professor Metchnikoff's idea of human longevity is similar, his view being that although diseases and improper modes of living now hold human life down to seventy or eighty years, these evils and bad conditions may be so far ameliorated, that old age will come three score years later.

We do not understand Professor Metchnikoff to teach that greatly prolonged life, looking to immortal life, can be attained by applied science. His position is, that "old age" may be deferred, not remedied; that it is in the end

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an unavoidable sequence to all organic life. The conception that sentience in matter is a constant, a deathless property or attribute of the ultimate ion and corpuscle, and hence that, founding on this constant, immortal life is potentially attainable and logically possible in organisms, perfected by applied science, is an essentially New World idea, a concept of the American brain, which is not as yet much recognized in Europe. It is one of those great dominant ideas of the human brain which unfold only as the westward-moving Aryan makes his new departures from continent to continent.

"This sentient property of matter is a constant like its corelative, gravitation, and indestructable as matter itself. It is the eternal well-spring of Nature.

"Here, on this eternal constant, the intimate life of matter, itself, founds the hope of a possible immortality for man. No vicissitude of earth has yet been observed to deteriorate its quality. Everlasting as the stars, it shines from the core of each ultimate particle of matter.

"Death comes to us, then, not from a law of nature. The law of nature is life, not death. Universal matter *lives* from eternity. It never dies, not even the least particle of it, but lives immortally. Life is the grand law of the universe from eternity to eternity.

"Our problem is to make a certain definite mass and form of living matter — an organism — live on this earth as long as the organism shall *will* so to do.

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"Each and every one of the causes of old age and death *is of the nature of an ordinary physical cause, fairly within human power to avoid or remedy, and many of which in fact we are every day avoiding and remedying.* It is the sum total of these causes which has rendered death a seemingly inevitable sequence to life. Yet not one of them but can singly be warded off by human science and foresight, and if one, why not all? It is a question of greater knowledge with us, not that we die from any immutable law of nature as heretofore held and taught.

"At length, after centuries of dogma, erratic faith, and equally erratic doubt, we are in possession of facts from which a creed may be rationally forecast. Those facts demonstrate the continuous evolution of life, under nature, from lowliest forms to man: a long, weary, and unaided struggle upward through organization, from the elemental sentience of matter to the human intellect. But is all this grand effort to terminate in the semi-brutal, half-developed creature, man, with his ideas unrealized? Has evolution ceased? On the contrary, it is our faith that we have as yet seen but the nether limb of evolution. Its grand complement has still to be disclosed in the perfecting of the human organism and the removal of the causes of disease, old-aging, and death; in a word, the achievement of immortality. Immortal life will be won by applied knowledge. Man will save his own soul.

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Earth is to be made heaven. 'Salvation' is to come from knowledge and the apotheosis of the race. This is what evolution means. This is what life on the earth is struggling upward to win: Immortality, Happiness, Heaven; ideals to be realized by human effort. The tenets of all the great religious systems foreshadow it. It is time to understand this. It is time to realize our true situation on the earth, and cease from chasing mirage. We have now sufficient knowledge to begin to save our own souls. As well face the facts of our mortal condition to-day as spend another thousand years doting on fond illusions. If we would live, we must save ourselves. This is the religion of life; the religion of self-salvation. It is not 'atheism'; not 'materialism,' in the old crass sense. Not 'infidelity'; rather fidelity to the best and the essential doctrines of all religions. Not 'skepticism,' but Hope and Faith in Life. Not the 'idle, new dream' of 'Scientific Materialism,' but the Dream of all the Ages, the grand scheme of Nature, maturing and going into effect since first our earth became the theater of life." *

But aside from these alleged ravages of phagocytes, there are functional causes of organic decline which come from lack of coordination and cooperation in the *ensemble* of organs and apparatuses of the body.

* *Living Matter*, 1888.

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To make this quite plain we must conceive of the organism as made up of thirty or more groups or differentiations of cells: bone cells, muscle cells, liver cells, lung cells, renal cells, epithelial cells, blood cells, nerve and brain cells; in a word, all the diversely specialized tracts and groups of tissue cells which together form the animal body and are necessary to that grand cooperative effort exhibited in a human life.

There must be a stomach, a liver, a pancreas, etc., for digestion; lungs for oxygenation; kidneys for elimination; and blood for the further transformation and transportation of the food to all the various groups of cells. All must be fed every second. Each organ and apparatus produces a different product; and all must labor together in a kind of organic rythm, balance, and counterbalance. And this rythm and counterbalance are very nicely and delicately adjusted, so much so, that the least aberration or dereliction from duty and function, disorders the entire organism. So much so, that it is the highest art of physiology to watch over the organic entity and preserve the balance of organic interaction.

But as years pass, one organ, or another, or many, tend from the wear and tear of life as we lead it, to become impaired and disabled. There are deposits of "formed matter," diminution of the numbers of cells from inflammations and poisonous ingestions. One organ or another thus fails to do its part, the balance is lost,

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vicarious action begins; what we term "constitution" is broken up and discordant action ensues. Most persons die of this organic discord.

A number of years ago, the startling statement was put forward, that organic decline, ending in death, comes from a progressive asphyxiation of the tissue cells; that after adult life, we slowly suffocate, from a thickening and hardening of the membranes of the alveolar sacs of the lungs, oxygen no longer passing freely in, nor carbon dioxide out. The hardening of the alveolar membrane is aggravated from impregnation by minute dirt particles in respired air; it being a well-established fact that the lungs are progressively discolored from infancy to old age; and that the lungs of certain craftsmen, stone-workers, dry grinders, and others, are very palpably thus impregnated.

As a proximate cause of organic decline, there must be something in this hypothesis, which will have to be reckoned with in any future effort to alleviate the causes of old age. But it can scarcely be said to go to the root of the matter, and we are still left to inquire why otherwise than by impregnation with visible particles of dirt, the alveoli become hardened, lifeless sacs, impervious to gases, instead of the living, pervious membrane of childhood. And this leads to casual mention of a theory of old-aging, suggested from this Laboratory in 1896, namely, the

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theory that the cells of all the tissues are slowly impregnated, embarrassed, and killed out by invisible dirt particles which are ingested with our food, enter the blood plasma, and finally reach the cell by absorption.

Dirt, which has been well defined as "matter in the wrong place," is commonly supposed to be a molar condition of terrestrial matter which does not prevail nor exist in the molecular realm. Hence, by virtue of this molecular exclusion and the elective power of living matter to choose and select such particles as it pleases for its nutrition, the protoplasmic cell has been presumed to be in the "chemically pure" state. There is reason to fear, however, that such an assumption is gratuitous and far from accurate.

Only a microscopist knows the full bitterness of the life struggle with dirt. It is doubtful whether even a gas can be, or at least has been, generated chemically pure, so omnipresent is dirt. Dirt is Nature's heterodoxy.

The animal organism is a great destroyer of dirt; that is to say, the various ferments and "juices," which it is the life work of many groups of the somatic cells to secrete, act chemically on dirt as well as on true food, on innutritious as well as nutritious substances, to break them down to the elemental condition. Having passed the digestive tract, too, and entered the blood plasma, still further reduction and elimination take place, before the

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highly rectified particles go to the cells of the nobler tissues and organs.

In an adolescent organism, normal, healthy, and strong, this eliminative process is practically adequate. Adventitious substances are expelled or broken down and resolved chemically.

But in older organisms, during periods of weakened action, the process of resolution is less complete; microscopic dirt may accumulate in enfeebled cells. If not dirt, what is that darker-tinted residuum in old protoplasm?

Is there dirt in the blood? Or rather, to how great an extent is the blood a dirty liquid? In other words, is dirt taken up, associated with nutritious particles, by the absorbents and lacteals?

We know that the fine particles of inorganic substances, administered as medicines and poisons, pass readily into the blood, and speedily enter the protoplasm of brain and muscle cells. In the examination of old amoebæ, which are nourished in dirty water, we see a great deal of this. Under high power the same is discernible in a culture of bacteria which can be killed out by an admixture of dirt in the fluid.

It is not of the chemical action of inorganic particles in the protoplasm of the cells that we are here treating, however, but of their merely negative behavior, or presence as dirt. A particle of arsenic, antimony, or iron may ex-

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cite protoplasmic action which may speedily result in its expulsion, resolution, or encystment, where a merely reactionless particle of silica, or lime, might remain as an obstruction. Is the somewhat discolored, more rigid, less elate condition of the fibrils of a brain cell, in an aged organism, due to infiltered, accumulated dirt?

The question here raised, as regards dirt, is whether minute particles of inorganic matter, or obdurate organic matter, entering the plasma of the blood, find ultimate lodgment in the cells, and remaining there undissolved, chemically unassimilated, or unexpelled, give rise to those aspects which distinguish aged from young cells. Are accumulations of microscopic dirt in the cells one characteristic of old age? Is all organic life from infancy to old age and death a hapless struggle with dirt?

Since 1896, however, we have seen reason to believe, that while the dirt hypothesis of old age contains scintilla of truth, it must, like the foregoing, be ranked with proximate rather than with primary causes of old aging.

Dr. De Lacy Evans also believed that old-aging resulted from accumulations of "earthy salts," largely phosphate of calcium and silica, in the tissues, and the unregulated wasting of the cell protoplasm by oxygen. This opinion has gone the rounds of both medical and popular journals, with variations. We now know that

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such earthy salts, to some extent and in some tissues, at certain stages of life, do accumulate in a way to embarrass the cell life and to weaken the tissue. But this condition is far from being constant, or continuous, or secularly progressive. It is incidental and often associated with microbic invasions. As to the undue wasting of the cellular protoplasm by oxygen, that is largely a myth; a far greater difficulty in old organisms is to get oxygen to the cells at all; they smother for want of it. An hypothesis of the old-aging of the nervous system and cerebral tissue of man has also been advanced from the progressive effects of continuous or oft-repeated mnemonic and sensory impressions in the protoplasmic substance of the brain and minor nerve centers.

Memory, experience, and the growth of the intellect depend on impressions from the external world which come to the brain through the organs of special sense and the general sensibility, and remain there as pictures. Such impressions, or pictures, are believed to be physically inwrought in the sentient substance by something akin to dynamic action, and, as is well known, will remain there, mentally recognizable, for many decades. From such portraiture of the external world, physically impressed in the material substance of the brain, we have what is commonly termed, experience. This experience, however, is something more than an accumulation of impressions or pictures; for it is accompanied by the formation of

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opinions and intellectual growth. There is assimilation of the collected data as well as mere accumulation; growth of the garner itself into an organic sentient whole, its substance being arranged, moulded, or impressed in such a degree, that a recent writer has not hesitated to define the "soul" as "the form of the organism."

It is a well-known fact, moreover, that the frequent repetition of the same impressions, as of sensory experiences, scenes, and sounds, has a marked tendency to dull our sensibility to them. Equally well observed, too, is the loss and confusion of memory in advancing life.

Hence, the inference that the constant repetition of impressions and the continuous bepicturing of the brain substance with mnemonic imagery has its natural, physical limits which cannot be long outrun without utter confusion and blurring of the material medium, as when one picture is printed upon and over another. And the conclusion derived, touching long life, has been that a lifetime greatly exceeding seventy-five years must, of necessity, result in mental dullness and confusion of thought.

Thomas Parr, however, at the age of one hundred and fifty-two, is alleged to have been "bright" and normal as to "all his faculties." Henry Jenkins, of Yorkshire, England, "distinctly remembered" the battle of Flodden Field, fought one hundred and fifty-seven years previously. Robert Evans, of Spitalfields, "clearly recollected" the

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execution of Charles I., one hundred and thirty-two years before.

What is known as to this subject goes to show that if the data of experience are normally assimilated with one's existent knowledge and incorporated as such knowledge in the mind, no confusion will result from their progressive accumulation.

In the aged, too, recollections of youthful years often appear to be revived and to grow vivid, although it is a matter of common experience that our memory of past events fades with the lapse of time.

Closely associated with the above theory of old-aging is the psychic theory, namely, that we age and die because after the purely animal or sensory cycle of brain development is accomplished in mating and procreation, there follows a period or condition of non-development. A new, higher cycle of mind growth is not initiated, and does not begin, with its new interests, new ambitions and fresh incentives to live and act. The brain neurons do not take a fresh start to live, and hence the stasis of advanced age ensues, with its common conviction that life has been lived, and that naught remains but to exist for a few years more and die.

According to this view, if it were the fixed belief of human beings, the current faith, that after the age of forty-five, a new cycle of life was to begin, a new, later course of study and preparation for another life effort

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would be inaugurated; and if the world and the social system offered a field for this (as in future it will do), then the stasis of advanced life would not set in; human beings at fifty would be seen brightening up for a higher, stronger life, with better, loftier ideals.

The chief obstacle to this at present, is not that these new cycles of brain development cannot be initiated, but that the world and society offer no field for it; the hostile presence of the younger generation pushes the adult generation off the stage of life. What is needed for prolonged life of the individual is field for him to live and develop.

We have abundant evidence in numerous observed instances, that at the age of fifty, sixty, or eighty, the human brain may enter on a new curriculum of study, growth, and achievement; and that, *pari passu*, with this new effort, the cell life of the whole organism has been notably quickened and strengthened. For it is ever the brain life which quickens, sustains, and maintains the life of the other organs and apparatuses of the animal organism.

A provisional importance must therefore be attributed to the argument for the psychic cause of old age. To the writer it is at least apparent that the first step toward the achievement of deathless life will be from the psychic side.

The assumption that the brain, progressively, is dulled by multiplex mnemonic impression founds on the idea

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that the brain is like a photographic plate or film. Whereas, what we know of the brain neurons leads us to conclude that there is little or no analogy of this kind; that the building up of a personal intellect bears no resemblance to photography. A human intellect, with memory, implies a corelated, cooperative effort on the part of many millions of cells, acting together, pooling their cell lives about a personal axis. Each cell is thus stimulated to live in a certain way, father than stamped by a photographic picture from without. The cell contents, or sentient substance of each cell, is in a state of constant flux and mutation, replaced every second by fresh particles, not "fixed" as in a photograph. An intellect is, therefore, a certain manner or mode of cell life relatively to the other cells of the entire brain, not a series of photographic plates packed away in the brain. The instances of double personality, double consciousness, and recurrent personality, indicate that when, from any cause the first or former personality ceases, a second personality may begin, as if about a new personal axis, and go on to develop another intellect of the brain cells, quite as if the first had never existed.

It is, therefore, fair to infer that if at the age of fifty or sixty, it was the custom of human beings to enter on a new cycle of brain life, and there were opportunity and social field for it, a new axis of personality would slowly take the place of the old, and that the cell life of the brain would

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arrange itself about it, quite as readily as if no former development had taken place. The problem of such prolonged brain life would lie in giving the brain cells a pure, normal food, through an uninjured blood circulatory, and preserving them from the ills that come from association with other impaired cell groups of the organism.

The brain appears to be a colony of cells destined to live forever and capable of doing so, but for the weakness, diseases, and frailities of the organism in which it has developed. On the one hand, it is the organism, by means of which, it has come forward and arisen to its present high estate of intellectual puissance; and, on the other hand, it is this same organism which now drags it down to death.

The "cometh up like a flower" theory of old age has long been a popular one.

When we regard the growth, blooming, and death of a summer flower, the shooting upward of the flower stalk of a poppy, for example, with its blossom, its seeding, and its suddenly ensuing juicelessness and dead rigidity, we contemplate phenomena not wholly unlike what takes place in the human organism, when regarded in the large, passing from infancy to maturity and old age.

What has taken place in the poppy stalk?

One class of plant cells has developed, multiplied, and

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from the products which have issued from them has produced the stalk proper and leaves. Immediately another class has, in like manner, given rise first to the bud, then to the gorgeous blossom with its stamens and pistils. Fertilization follows in its timed order; and later another class of cells matures as seed.

It has been held that these latter cells in some manner sap and eviscerate, so to speak, the cells of every other tissue of the plant, and thus sapping them of their life elements, or germs, condense these latter in the seed, where it may long lie dormant, yet capable of producing another plant; and that the parent plant, thus sapped and eviscerated, dies naturally, its life being virtually taken away and carried forward to the seed for another year.

The observed fact that the stalk and lower leaves of the poppy remain green until late in the season, if the flower stalk is nipped, has been regarded as evidence of this view; namely, that the phenomena of its growth, maturity, and dry death stand for a development, successively, of one class of cells after another, from the seed around to the seed again; that the plant dies when the germs of life have left the stalk and leaf and passed upward to their final lodgment in the seed.

It is an easy theory, easily derived, easily argued, and falls in superficially well with certain aspects of the cell doctrine and with current theology.

But it carries a great and vicious untruth; vicious in

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that it would indicate that the primary and ultimate object of all plant life is to bear seed; of all animal life, to bring forth offspring.

Per contra, we believe that the object of all life, vegetable and animal, is to live and feel the joys of living; and that seed and offspring are produced because, under the hard conditions of the earthly habitat, we are unable to live on continuously. That is to say, if the earth had always been an easy habitat for life, *there would have been no seed, no offspring, no death.* Offspring and seed result originally from hardships and prospective death to the parent cell, and are not the object of living, but rather an evasion of death.

It seems to me very desirable to have these premises right at the outset as contrasted with the contrary view, and to set off free from a radically wrong theory of life.

To return now to our observation of the poppy stalk, whatever of fate, of final tendency to go to seed, there is in it, will be found due to heredity, established by long conformity to climate and other conditions; a habit of living which leads the different classes of cells to develop and produce tissue at a certain time, relatively to each other; and in the manner in which these different tissue growths of the stalk and flower limit and restrict each other.

It is now more than doubtful, and is discredited, whether anything of the nature of a migratory germ, or "biophor,"

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ascends from the tissue cells to the seed, and is thus transferred from plant to plant and year to year.

Why does the poppy live? It lives to express its life, its personal life, and to take its personal satisfaction from living. It is an organized effort at fruition on the part of sentient matter. Seed is its mode of escaping death. We have radically to change this former conception.

But granting the general truth of the doctrine that seed and death result primarily from the hard conditions of terrestrial life, which make it impossible for metazoons to live on continuously and deathlessly, it has been argued that all existent forms of life have fallen irretrievably into this mode of living and dying. Not only do the same conditions of hardship and limitation still prevail which first induced seed and death, but every plant and animal lives by virtue of, and in accord with, a plan or an arrangement of the germinal matter in the seed, which compels it to unfold as did the parent, and inevitably produce seed and die.

That is to say, the arrangement of the protoplasmic molecules in the germ, seed, or ovum, is such that the successive growths of tissue must, if the plant or animal is to live at all, succeed each other according to the order of their arrangement or garnering in the germ.

In the main, this view must be conceded to be upheld by the facts. Heredity does thus hold all forms of life within its iron clutch. Plants and the lower orders of

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animal life tend not to change, and for the most part would perish if suddenly altered conditions compelled great changes; and it is but to a single tissue, even in the human organism — the cerebral tissue — that we can look with any confidence for a successful contest with the restrictive dominion of heredity. That one tissue is still progressive and capable of self-direction and self-elevation.

There is also what may be termed the hypnotic hypothesis of old age, the idea that old age ensues from a fixed belief, or mental expectation, that it will occur at a certain age. That from earliest ages this expectation has taken the form of creed and acts, after middle life, as a species of inveterate hipnosis, compelling the person to behave after a senescent fashion, and feel the sensations and even experience the pains of senility.

In a word, that we grow "old" because we believe that we shall grow old. It is, therefore, an attitude of mind that causes old age; and the inference is, that if a fixed belief that man is deathless and will never grow old, could be substituted for this, his present belief, greatly prolonged life would follow.

In support of this theory, the well-known physiological effects of innervation are cited. Muscle cells severed from their connection with nerve and brain soon atrophy and die. The same is true of other tissues. Stimulation

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from the brain and spinal cord is necessary to the life and function of all the associate tracts of cells. These live only from their connection with the brain and are dependent on it for *motif* to live and work. It is this pre-eminent brain colony of cells which not only controls and dominates, but continuously furnishes the stimulus — the tide of corpuscles — that impel the servile tracts of cells to activity in their appointed ways. Severed from the brain they turn idle, run riot, or lapse into desuetude.

Moreover, there is the vast array of observed phenomena where fixed beliefs and the mental state, known as expectation, are seen to have profoundly affected the operations of the human body, even to producing the semblance of virulent diseases and death itself; of scar, stigmata, and all the strange phenomena that ensue from religious exaltation. In fact, the evidence is complete as to the brain's dominancy over the organism.

Of the hypnotic theory, however, it must be observed that it fails to account for the old-aging of animals, insects, and plant life.

A celebrated physician was accustomed to say, that "a man is as old as his arteries;" and from this dictum, which has its grain of truth, has come what may be termed the blood-circulatory theory of old age. Succinctly, that excluding what may be classed as accidental deaths

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from bursting arteries or veins and from arterio-capillar schlerosis, there is in aging organisms a slow chemico-mechanical contraction and diminution of the caliber of the capillaries, which results in starvation of the tissue cells, from exclusion of the blood corpuscles and even of the blood plasma. Oxygen and nutrient particles are from this cause slowly excluded from the cell which starves like a captive shut up in a dungeon. The progressive shrinkage and diminution of the capillary-tubes has been ascribed to chemical changes in the "formed matter" of which they are composed. In foetal life capillaries grow forward from a terminal cell-bud and are hollowed into channels behind the cell as it advances. It has been argued that after a certain lapse of time, this formed tube deteriorates from chemical instability, irrespective of the personal life and without reference to it.

A quarter of a century ago, when research was younger, many of us fondly believed that we held the key to the vital situation in a discovery — then believed authentic — that unicellular life was naturally immortal; that certain infusoria, bacteria, protozoa, meaning the first simple forms of life, lived and multiplied by fission and division without dying; that there was really no such calamity as death in this primary form of terrestrial life.

This fact, if fact it had proved, was perceived to be of

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tremendous significance. It opened vistas of great hopes. For it was already recognized that unicellular life was the basis of multicellular organisms. If, therefore, these structural units of our bodies were deathless under nature, the whole question of immortal life for man resolved itself into one of proper care and husbandry, protection and nutrition, of the physiological cell. Systems of such cell husbandry began to be outlined for practical use; and in the minds of many, the "fond dream of all the human ages" seemed to be on the eve of realization. The hope was logical, the deduction legitimate, if these premises concerning the natural deathlessness of the unicells were true.

Prof. August Weissmann — whose theories of life and death are now common property throughout the world — made the natural immortality of unicellular life one of the foundation stones of his famous hypothesis; other German histologists concurred, as also several noted English biologists; and for ten years we really seemed to be at the bottom of the great problem of life on the earth. It was then more logical to argue that the attacks of disease bacteria, acute and chronic, might be the ultimate cause of old-aging. For we contemplated the human organism — the soma — as composed of cells, not essentially unlike unicells, and originally derived from them; and if these component cells were deathless unless crushed by violence, starved, suffocated, or otherwise killed, the problem of

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prolonging human life indefinitely would be solved when we could ward off cell dangers in our bodies. With the somatic cell potentially immortal, death was due to organic errata. Our lives rested on a fixed and sure basis of immortality which was in plain view; the neurons of the brain were so many units of eternal life, if only we could guard and protect them.

True, Professor Weissmann took the ground that mankind continued to die periodically because prolonged human life was not useful to the human species; in a word, that the individual existed solely for the good of the species; that we die after we produce offspring because there is no longer any reason for us to live; and that this must be accepted as the law of human life.

It required but a normal exercise of common sense, however, to discern a palpable fallacy in this corollary of the Weissmann theory. Hence, those who hoped for greatly prolonged life, from the growth of knowledge, were not disheartened; for they recognized the fact that the highest interests of the species will be conserved far better by a race of perfected individual organisms which were deathless, than by constant generations of diseased mortals. It was perceived that the only possible reason for thus exalting the species and sacrificing the individual on its altars, must lie in the expectation that ultimately there would be developed from the species a race of more perfect individuals.

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The species, indeed, as conceived of in the Weissmann hypothesis, was merely an abstraction; the individual after all was the desideratum; — but little points like this sometimes escape the minds of great philosophers.

It must be confessed, too, that something equally nebulous attaches to the Weissmann theorem of the *Germ-plasm and Heredity.*

The Germ-plasm of Weissmann is the human reproductive tissue, a cell colony which lives on, deathless, from generation to generation; the *soma* alone dies; the germ-plasm has survived from the time unicellular life was the only form of life on the earth. Rejecting the theory of Darwin and others, that gemmules from every cell of the organic tissues are garnered in the reproductive tissue, to be extruded as embryonic cells, Weissmann taught that the reproductive cells, by permutations and combinations of the germinal substance, are equal to the task of originating new generations of mankind, unaided, and that the *soma* has nothing to do with reproduction save the servile task of bearing the germ-plasm forward in the world and supplying it with food.

Here, again, common sense could not help thinking that as between these rival theories of reproduction, the truth may lie midway; that the despised *soma* while not transferring organized "gemmules" to the reproductive cell colony, may yet by virtue of "nervous currents," which pass to and fro, so influence, mold, and *individualize* the

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germ-plasm as practically to impress the ancestor on the offspring, and virtually reproduce the parent in the child. This view, at least, had the merit of reconciling opposed theories; and — saving clause — it is not clearly known as yet in what "nervous currents" which reciprocate between the reproductive organs and the rest of the body, consist, or how fully representative of every organ and tissue of the body they may be. A "nervous current" is a great mystery and involves many unknown quantities and qualities of matter; it is a fruitful field for investigation. When we are able to analyze a "nervous current," we will know a great deal more about human life than at present. It would not surprise the writer, if a "nervous current" were found to be capable of transferring the image and character of one cell to another. It may prove a stream of an almost infinitely more minute form or type of "gemmules" than Darwin dreamed of, or Weissmann repudiated.

Then in 1885–86, and for a time, this sense of certitude, this feeling of mastery of the great problem, was given a rude shock, by deductions drawn from the observations of Maupas, confirmed by contemporary biologists. Primitive unicellular life was not deathless in any sense, after all. The intimate causes of old-aging were found to be deeper-seated. The unicell was seen to "age" and die,

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even as the multicells. The Weissmann hypothesis associated death with sexual reproduction in the multicells, and portrayed the causes of death as organic and extracellular. We now learned that the causes of death are intracellular. Colonies of unicells congregate to be regenerated by blending and exchange of particles, sexually, not differently in principle from the sexual congress of animals. Unicells increase in number by division of the adult, parturient cell into two smaller "daughter cells," each of which grows and divides into two others, generation on generation, for a limited length of time, but not indefinitely, as was at one time believed to be true of them.

On the contrary, after a certain number of cell generations such unicells must get together sexually. The millions of rhizopods in a stagnant pool, for example, must thus congregate or they will cease to be reproductive and the species will die of old age.

As observed by Maupas in 1885–86, and other observers since, sexual conjugation is accompanied by profound changes in the cells. The technique of these changes is of less consequence here than an appreciation of the principle involved. When two of the conjugating cells have paired and come into close contact, the paranucleus, or sex organ, of each suffers a species of dissolution; it divides and appears to undergo a kind of reorganization; certain parts of it are rejected altogether and cast forth,

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as if worn out, worthless, or deleterious. The remaining parts of the paranuclei then come together and are differentiated as a male and a female pronucleus. All this seems to take place as if under stimulus of contact, or of sexual desire between the two cells. Having paired, these changes in each begin and proceed as above indicated. Immediately then the male pronuclei cross over from cell to cell, the female pronuclei remaining stationary. After passing over, the male pronuclei unite and fuse, each with the resident female pronucleus. A transfer and exchange of germinal matter from one cell to another is thus accomplished.*

Following this exchange, a complete reconstruction and reorganization of the entire nucleus of both cells takes place. And now the two unicells, having affected this swap-over of germinal matter, and this profound reconstruction, slowly separate to go each its individual way as before. Each feeds and grows and in due time begins to multiply by fission and division in halves, which form new individuals; and this asexual increase may go on for fifty, a hundred, or even six hundred generations.

Maupas' observations indicated that sexual conjugation did not take place successfully between unicells of the same family, that is, between descendants of the same parent cell. The disadvantages and observed enfeeblement, which result from inbreeding in animals, and in consanguineous marriages, appear therefore to be deep-

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seated in unicellular life. Sexual conjugation gave best results when the cells were of "stranger" parentage. If sexual conjugation were too long deferred, till the successive generations had grown very much enfeebled and senescent, it was either unsuccessful or failed to be undertaken. Under natural conditions it took place when the individual generations were at their best.

Why individual generations from the same parent fail to conjugate with entire success, is thus far as little understood in unicells as in animals. The proper elements for the sexual reaction appear to be lacking, as if there were too great a sameness, too much identity or similarity in the sexual elements of the paranucleus and pronucleus. To obtain the needful sexual reaction or stimulus between the cells, they should come from another stock and have been nourished in another place, in a different environment.

Where sexual conjugation did not take place the generations from the same cell parent, as time went on, became smaller and often deformed. After several hundred generations the descendants of a single cell parent all die and the line becomes extinct.

In principle nothing different takes place in multicellular life in animals and man. There are modifications of the same method, due to the extensive organization of the cells, but no departure from the principle of cell renewal by an interblend of the nuclear substance of two cells,

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This point should be kept clearly in mind, since it helps to place the whole subject under better lights. Cells from the reproductive tissue of one parent (spermatozoa) meet a cell from that of another parent, and the same interblending and fusing of nuclear elements takes place, followed by a recast of the blend, and then a new life developing in due course.

At first, and for a number of years, the discovery that the unicells age and must have recourse to sexual conjugation, to escape death, was most disheartening to the earlier hopes of natural salvation. Death appeared to run far more deeply in the warp and woof of living matter than had been supposed.

For a time we were inclined to acquiesce in the extreme view that this observed decline and aging of the cell-of-life was due to an inevitable, irremediable exhaustion of the vivific molecules of the cell nucleus. That even if the number of protoplasmic molecules were restored by adjuvant chemical action, we might yet find that the wear and tear of cell life depletes the large mobile molecule, itself; and that the problem of its restoration might be found out of range of the chemical activities and affinities of terrestrial matter. In brief, that death reigned irretrievably on our planet, and that life is possible here only in the parent-and-child mode. For it was easy to

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go farther and theorize that molecules, atoms, and even ions and corpuscles are depleted, and have to meet, sexually, for renewal. There have been various fanciful theories as to sex in the most minute particles of which matter is composed.

These were years of doubt for the natural salvation idea. The deduction then made, was that the hard conditions of life on the earth, cause the cell to wane, deteriorate, or "run down," to the extent that it inevitably dies unless reincarnated by sexual interblending with other cells, that being nature's only method of getting over the inherent obstacles to terrestrial life: obstacles incident to gravitation, avid chemical activities, and the heterogeneous mixture of matter on the earth's surface. And this deduction touching unicellular life is a true one. The unicells have found life too hard to live endlessly as individuals. Under the ordinary conditions of shore and pool, they die out unless renewed by sexual regeneration; — and this is the death of the individual life.

It is race life, not individual life, which is perpetuated by sexual renovation; the child may be like the parent, but is not that parent, personally. Those who have observed the profound changes, the commingling and regrouping of the cell contents, that precede the fission and division of a unicell into two "daughter cells" — even when not immediately antedated by sexual congress — must needs conclude that the parent does not live on in

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one of these cells, but came to an end, personally and individually, at fission. So that the declaration of Weissmann and other biologists of that time, concerning the immortality of the unicells, was erroneous from the start, founded on faulty observation; the fact being that a unicell always dies, personally, when it gives birth to offspring by fission; the profound break-up and reassembling of the nuclear contents *being equivalent to the obliteration of the parent cell as an individual.*

But in accepting this grim conclusion, touching the mortality of the unicells, those who had hoped that the human organism may be perfected for greatly prolonged life, looking toward immortal life, overlooked for a time a most important fact, and failed to take cognizance of what nature had itself been doing to alleviate these same hard terrestrial conditions which cause death in unicellular life. We failed to perceive that in every organism, animal, or plant, a united, continuous effort is made to render cell life easier and safer, to provide a better cell food and secure more perfect nutrition, to eliminate poisonous substances, and remove "dirt."

We failed at first to comprehend that while in exposed, unprotected unicellular life the individual could not live for more than a few days or weeks at most, and was obliged soon to resort to reproduction to escape race extinction, cells could be found in multicellular organizations, the brain of a man or an elephant, for example, that

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live for a century, or two centuries. In short, that multicellular life is a long-established, cooperative method on the part of cell life, to live longer and better, looking to complete salvation under nature.

At that time we failed to comprehend this larger effort of cell life. Our mental concepts did not then as now embrace the outlines of the Earth's life scheme. Nor did we then perceive that these grand cooperative unions of differentiated and specialized cell life give rise not only to animal organisms, but to a higher, organized, personal life which redacts strongly to preserve and perpetuate the component cell units, and that the more intelligent that personal life becomes, the stronger grows the effort for self salvation.

To have a human personality, with mind and reason, with memory running back to childhood, binding the entire life experience together and blending it in a coherent whole, the brain neurons must largely survive throughout the personal life-time, the cell must live on, its individual life must be preserved.

This marvelously organized animal body which we inherit, the origins of which are in the depths of unhistoric time, has come up under nature, self-maintaining, self-repairing, in obedience to an instinct and impulse to live on and not die. It is the embodiment of the cell effort to

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be deathless. It started and developed to that end. The impulse to this comes from the sentience of the cells — the sentient side of matter. It is a self-sentient mechanism which feels its hurts and possesses the resource of self repair. From perception of injury issues energy for restoration, as, for example, when a muscle is wounded, or a bone broken. Even the blood circulatory tubes grow again, and are repaired and reopened, round and about, as the wants of the tissues make urgency. Wherever a sense of loss, damage and danger is felt, this current of *vis viva* stimulates the phagocytes to act and sets the cells of the injured organ in extraordinary activity to produce new tissue. Something more and in addition to chemical action is displayed here; it is chemical action, prompted and initiated by sentience, by a swift current of minute corpuscles, out-flowing at the command of self-consciousness, bearing its will to the cells.

It is the nature of this current, this stimulus from the neurons, that we have great need to study and control; to learn how it may be generated, artificially perhaps, and how it may be used to stimulate repairs throughout the organism.

We have a working hypothesis as to how currents of negative-electric corpuscles are derived in the cells to issue forth as the vehicle of their will. Apparently it comes from decomposition of the atoms in the protoplasmic molecule; a decomposition initiated by the cell's self-

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sentience. It starts from the sentient side of matter, and involves a great law of nature and the cosmos; — but the scientific evidence in proof of this is not yet in form for statement.

The growth of biological knowledge, during the decade, has greatly enlarged our conceptions of what the cell-of-life is capable of doing and becoming. We are recognizing more fully than ever before its inherent plasticity and marvelous adaptability to every form and use in organized life. And when we contemplate these astounding metamorphoses as seen in the intricacies of insect mechanism, the beauty of flowers, the texture of ivory, bone and shell, the coining of spore and germ, the achieved resistance to cold and heat, and, in brain, the elevation of simple sentience to intellect; when we contemplate these marvelous achievements of the cell, past and present, there seems no good reason to doubt that this same cell may achieve greatly prolonged life — if it sets itself to the task. Prolonged life would be a feat no greater than others which it has accomplished in the past. Our survey of organized life constantly strengthens this conception of the cell's plasticity and its possibilities. It may be moulded, bent, and directed to do almost anything, perform almost any function and live briefly, or long, as the greater life or personality of the organism enjoins upon it. It is

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Nature's Proteus and may be made to live a day, or a millenium.

For slowly, over the stumbling-blocks of many errors and misleading hypotheses in the past, we have been drawn to the conclusion, that although the tissue cell is still seen to decline and die with the organism, there is attainable for it an exceptionally well-nourished, well-protected condition where it may live on without time limit. We mean by this that the alleviation of old age is now more largely a question of regulating and controlling the life of the organism — this larger personal life — than of combatting intrinsic obstacles to long life in the cell, itself; that it is the organism rather than its component cells which must be put in trim for longer life. What the cell needs to insure its continuance in function and in life, *is stimulus from the organism as a whole*, and that atmosphere, or *aura*, of vitality, which pervades a healthy, strong animal body; that so long as these stimuli remain constant and strong, and the cells are well nourished, they are not of themselves the initiating factors of old age. It is the whole life of the organism that quickens cell life; that is to say, the volume or sum total of cell life in the animal body when well blended in a vital aura, seems adequate to stimulate and maintain in healthy function each individual cell of the vast union for much more than a century. Blended together, these millions of cell lives maintain a stable vital atmosphere, which sustains, invigo-

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rates, and redacts, and but for organic rather than intracellular errata, would do so indefinitely, if the cells could be well nourished and protected.

Yet, let no misapprehension accompany this deduction. The cell is itself a small organism which does not as yet live so perfectly in the animal body as to be free from the errata of earthly life, and hence is not yet free from the "old age" tendency. It, too, still suffers a deterioration, probably, even in the best constituted organism, although the ideal and intent of the organic union is to purvey for the cell a perfect, deathless life.

We mean, that owing to imperfect food and imperfect living generally, the component cells of the human organism still suffer a progressive involution which in the course of two centuries, perhaps, would bring the organism to a stand-still, and cause it to die of true cell old age. For there is organic old age and cell old age. Our problem of alleviation concerns both, but at present the former more urgently than the latter, since apparently the deterioration of the somatic cell is self-remediable and may be left to remedy itself under better conditions of nutrition and protection. It is therefore to organic old age that scientific effort can be most advantageously directed at present.

Such is the human situation on the earth, a situation which appears to have come about, under nature, without

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let or hindrance from external worlds. It has been an unaided, and, so far as the scientific evidence goes, an unwatched, unprotected evolution from the lowly, primitive sentience of matter.

At what will it finally arrive?

Or, in the light of our growing knowledge, what can we make of it?

This, at least, is fairly certain of it, that the continued effort at natural salvation will remain our own, unhelped, unhindered. If we can save ourselves from "sin" and death, well and good. There seems to be liberty to do it — a working chance for it; and the question constantly recurs, what can we do to this end, personally, individually, to forward the grand intent of life to natural salvation? What can we accomplish, or illustrate by personal effort in our own organisms, in unison and harmony with the cosmic push of life? How shall we best labor and throw the bent of our lives in consonance with it, convinced that in thus squaring ourselves with the universal trend and purpose of living matter, lies the only true nirvana for individual life.

Without further consideration we may put aside the idea that any one agency, "elixir," "serum," or extract from plant, or gland, will prove a cure for old-aging, although these may help. "Old age" is a condition too

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vastly complicated and dependant on too many diverse causes to be thus singly cured or counteracted. There must come an amelioration of all the causes, from the psychic side as well as the physical and physiological; by which we mean to say, that prolonged life will not come till prolonged life is personally felt to be worth living; until the basis for enjoyment of it is established in the brain; until our lives are measurably lifted above the present fleeting sensory ideals. Amelioration and removal of all the causes will be ultimately required.

One of the first, most practical steps to this end is the subjugation and extirpation of the disease-producing bacteria. This great campaign, along the well-known lines of sanitation, sterilization, and immunization, is now fairly inaugurated; its progress is a matter of daily news.

The second step in order of importance and timely need, is an extended study of nutrition — the nutrition of the somatic cell — with the acquisition of accurate knowledge how the cell assimilates and of what its proper food consists, with a view to supplying that food, or form of nutriment, to the cells and relieving wholly or in part the present hard, exhaustive processes of digestion, peptonization and rectification, which set up so heavy a drain on the powers of the whole organism, and now devote the human body largely to animal and vegetative functions. An *invented*, rectified cell food, raised to a high degree of molecular instability, decomposing easily and giving off

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its corpuscular elements freely, is the next discovery most needed in our quest for deathless life.

Work along these two great lines is indicated with certainty and is urgently demanded. The third most promising line of effort lies in the husbandry of the nervous system, *per se*, the intelligent cultivation of the brain colony of cells.

This is a wholly new line of effort, to which little or no attention, in this sense, and from this point of view, has ever been given.

Education as we now obtain it is an exhaustive process, pursued without regard to the life of the brain cell, and, in truth, without recognition of its existence.

In organic and in cellular old age, the cells of the brain and spinal cord share at length and are borne down to death, but as a rule, are the last to give up the struggle. Soft and easily dissoluble as brain appears to be, it is yet the most vitally resistant of tissues, perhaps because the best protected and best nourished. Brain cells secure nutriment from the blood-stream, while muscle cells, bone cells, and gland cells starve. Intellect confers strength and endurance. Here, as throughout nature, knowledge brings an endowment of power. The brain colony is the most enduring of cell unions.

To begin with conditions easily recognized, it may be stated, without metaphor, that after the age of thirty-five, most persons, especially Americans of this generation, die

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because they are literally tired to death. After education begins, the brain cells are rarely or never sufficiently rested from day to day, and there follows what may be termed cumulative fatigue. Improper food taken at bad hours, with abnormal excitements and untimely stimulation play their part, with the general result that there is as an increment of unrelieved fatigue going over from week to week and month to month, until an abnormal condition is reached where restful sleep is no longer possible.

In typical American cases, these cumulative effects of unrelieved fatigue begin in youth and set up a series of changes in the brain cells which result either in the popular "nervous prostration," or more frequently, in an abnormal shrinkage of the mental life, a diminution of personality, accompanied by sub-innervation and lowered vitality.

In this latter condition the organism is dangerously subject to invasions of the disease bacteria. This lowered vitality from insufficient or faulty innervation — the result of chronic brain fatigue — is primarily the cause of many prevalent diseases, since the germs of these diseases are always quite constantly present, and whether they are resisted by the nervous aura and destroyed by phagocitosis or not, is largely a question of normal as against subnormal innervation.

This condition is often set up in children at school,

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under improper conditions of study, faulty nutrition, or eye strain, in some cases going on rapidly to complete nervous break-down before the age of twenty is reached, but in most instances impairing clear mentation and inducing various phases of ill health before middle age.

A lamentable number of cases also occur in adults, as middle life is reached, among ambitious, hard-worked business men who may have passed school and college with nervous systems not greatly impaired, but encountering the cares and exigencies of business life, find themselves unrested from day to day, nervously depleted and victims of insomnia. In these cases the kidneys immediately suffer.

Several of our physiologists, Professor Hodge among the first, have demonstrated the visible, physical effects of fatigue in the nerve cell, the shrinkage in substance and the lack of functional power; also the direct results of rest and food for the restoration of a tired cell to its normal size and condition of dynamic efficiency. Sleep, with the diurnal darkening of the hemispheres, is the time when all the millions of brain neurons cease acting in their united, corporate capacity and revert each to its own personal, unicellular life. Through the hours of daylight they act together, as a whole, for the good of the entire organism. But now, when sleep supervenes, the cells let go hands, so to speak, continuity is broken, the resultant self-consciousness stops short, the personality ceases, and

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each individual cell attends to its own personal affairs, namely, nutrition, expulsion of waste products, self-adjustment, and rest. Sleep is the time when the brain cell is again living the original unicellular life of its remote ancestry, resting, restoring its powers.

So exhausting is the daily, corporate life, the maintenance of the intellect, that this succeeding period of unicellular life is necessary to the neuron's restoration. It must have time to attend to its unicellular wants and necessities before again devoting itself to the united brain life of another day.

It is not difficult, therefore, to understand what takes place when from any cause, the cell is prevented from properly attending to this its necessary individual life, that is, when it does not wholly break continuity with the other cells; when its waste products, accumulating during the day, are not cast forth; and when it is not permitted to pass into a state of cell rest. Disturbed, broken sleep leads to constant interruptions of these necessary processes of unicellular life. The brain is now like an army of soldiers, harassed by constant night attacks, to the extent that the individual soldier is kept in line, day and night, with no time to eat, sleep, or attend to his personal wants.

The brain cells, although still unrested, and but half purged of their waste products, are compelled to resume unification in self-consciousness, when a person wakes.

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In consequence, they enter upon the labor of another day, fagged, unrested — the condition which thousands of our people know so well.

In time, these cumulative effects of unrelieved fatigue show themselves in depressed function throughout the organism; the organic harmony is vitiated; nutrition is permanently impaired; and a shrunken, deranged condition of the neurons becomes chronic. *Pari passu*, the personality slackens, and character sinks to lower levels. In fact, it is not too much to say that humanity at present is composed largely of the chronicly tired. The process of cell deterioration begins, and the first downward step is taken, when we rise in the morning with a distinct sense of being not yet rested, and enter on the toils and duties of the day still unrefreshed.

In America, at present, no other one reform is so urgently demanded for the national well-being, as proper, normal rest for the brain cells of the people. After the age of thirty few among us know what natural sleep and sound rest are, or ever will know again. For many have passed the point of brain damage where sound rest can again come to them. Thousands of these hapless ones take refuge in that dreary land of drugged slumber, where chloral, morphia, and the later host of commercial nostrums hold nightly orgies over "the carcase of murdered sleep." These are, indeed, "lost souls" who, like weary Macbeth, will never sleep properly again.

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All of us who have had a normal childhood and youth, can recall the time when we were wont to wake in the morning feeling rested, with a willingness to rise and resume the business and pleasures of living; when we wakened with a happy sense of having been soundly asleep, so soundly that the world looks almost strange for the moment in its newness. That is the normal time, when the neurons are properly refreshed and renovated; it is that ideal condition which we should strive to maintain through life.

How properly to cultivate, nourish, and guard the brain neurons, in order that they may form a strong personality and generate a protective aura of health — that priceless *vis medicatrix naturæ* — is a most important inquiry, so important, indeed, so pertinent to our quest after longer, happier life, that the culture and husbandry of the brain and nervous system will be the subject of our next paper, in the edition for 1907.

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Self-Conservation and Self-Maintenance

The Culture and Husbandry of the Brain and Nervous System

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SELF-CONSERVATION AND SELF-MAINTENANCE.

THE CULTURE AND HUSBANDRY OF THE BRAIN AND NERVOUS SYSTEM.

THE line of physiological effort, suggested in the following paper, is a new and hitherto untried one; nor does the writer pretend to describe, or even to know, all the reflex or secondary effects which may ensue from it. For while in one sense, the effort is as old as life itself, since it goes on sub-consciously in every animal organism; yet in the sense of conserving and using the nervous energy (vim) of the brain and spinal-cord cells for the purpose of self-preservation and self-maintenance — using it consciously with a set purpose — the effort is wholly novel.

More than novel. It is revolutionary, subversive of the old ideas of human life, and has in it the promise of a new era of brain growth, a new departure in will-power; — but one strictly in line and keeping with Natural Salvation.

For the cure of disease and the prolongation of human life, hitherto, external agencies have been invoked, namely,

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medicines, prayer, or faith in Divine aid of a miraculous nature; that is to say, agencies external to the human organism.

Sharply in contrast to these, our present method is subjective and depends on the cultivation and training of agencies within the organism and normal to it. It rests on grounds herein previously demonstrated, that the human body is an organization of living cells and their products; and that its energies are the united energies, or lives, of the component cells.

Animal physiology founds on cell physiology; animal physiology, indeed, is cell physiology in its larger, grosser aspects. To comprehend in any proper, modern sense the functions of organic life, we must first study the life and functions of the component tissue cells; for this cell life is to the animal life what the single note is to the whole oratorio.

In our study of the thirty or more groups or tracts of tissue cells the lives and functions of which make up the composite life of man, our attention and interest come inevitably to center in that remarkable group, which, originally not unlike other protozoons, have, as metazoic life developed, become the brain and nervous system; the tissue of the personal self-consciousness and intellect.

The protozoon, every cell-of-life, indeed, feels, is self-conscious, possesses rudimentary psychic powers and lives a lowly, personal life. But in the animal organisms,

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preeminently the human organism, we find a certain group of cells which has made psychic effort and thought its business; just as the muscular group of cells assumed the business of contraction and locomotion. To the brain cells fell the magisterial function of *sensing* the environment for all the others and directing what all should do for the common good. And hence, as the organic evolution proceeded, we find this brain group of cells putting forth fibrils and filaments to the superficies of the whole united mass, filaments which in time assumed the form of the sensory nervous system; and also other filaments to all the other tissue groups for conveying the behests of the brain group, to become in time the motor system of nerves.

The better, too, to accomplish the function of sensing and thinking for all, we find the brain cells uniting in a consentient mass by means of a mazy system of interlacing fibrils, thus enabling the entire congeries of cells to live together and think in unison as one great cell might feel and think. We find all the principal cells, or neurons, of the brain group thus sentiently united and unified.

The brain-cell group therefore presents the aspect of a group within the other groups, protected and housed about by thick bone and tough integument, sentiently unified about a single axis of self-consciousness and devoting itself entirely to psychic operations, governing all the other groups, innervating all and compelling all to act each

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within its province for the common good. In a word, holding all together in a human life.

In the human organism the sway of the brain and cord cells is far greater even than is self-consciously apparent to the person; for the larger portion of it is sub-conscious; for example, the functions of the cerebellar and medullar centers and those of the spinal cord. This cerebro-spinal group of cells, indeed, upholds, maintains, directs, and governs all. It is at once the personality, the intellect, and the source of innervation. Deprived of it, the other groups of cells cannot go on living together, nor yet living at all.

It is apparent, therefore, that every effort to conserve and prolong human life must be made through this exalted brain group of cells; the brain and its out-reaching nerves. Yet every unicell of the ancient earth could do in minor degree everything which a brain neuron can now do. It could feel, it could see, it could hear, it could smell and taste; in a rudimentary way, it could think, and it was self-mobile; it could generate, *by willing*, dynamic impulses for locomotion, or for aggression, or for defense.

We now wish to examine and study this latter power or capacity of all cell life, namely the power to generate dynamic impulses *intra se*, by willing it, and make those impulses felt on its environment. And it need hardly be added here that this is the most wonderful transformation

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of energy known in the universe, the correlation of self-consciousness with matter-moving energy; the inauguration of chemical activity in protoplasmic matter by an exercise of the self-conscious will of that matter. The matter in this dot of protoplasm, the protozoon, is ordinary matter, differing from that about it only in its arrangement and organization; but here we see it display self-consciousness and the ability to *will* motion in its own substance, and set contiguous matter in motion.

The static self-consciousness of the cell wills motion and motion results. In the will of this living dot of protoplasmic matter, we see the germ of omnipotence. This embryo omnipotence resides in the brain cell, in every cell-of-life. Deeper, it resides in every last corpuscle of universal matter; for the cell is but a self-organized aggregation of corpuscles and atoms.

It is here, therefore, that our studies, looking to the control of the energies of matter, the conquest of the universe, must begin, to wit, in the cell-of-life and in the light of our new knowledge of matter.

By the phrase, "our new knowledge of matter," we refer, of course, to those later discoveries concerning the intimate structure of "atoms," with which the researches of Thomson (Lord Kelvin), Rutherford, Becquerel, the Curies, and many others are identified; researches of the greatest importance to the biologist as well as the physi-

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cist, since it is by aid of them that we now gain a deeper insight than formerly into the nature of cell life. For matter ever presents itself to our inspection in twofold guise, the objective and subjective, the physical and the psychical, the personal and the impersonal, the *self* side and the *other* side.

The atom of our older chemistry is now demonstrated to be a dynamic union of vastly smaller bodies, known as corpuscles, or electrons. Moreover, the "atoms" of certain elements of matter are known to lose their component corpuscles and waste away, becoming erelong the "atoms" of another element of less atomic weight, as in the case of uranium and radium. In a word, that the "elements" of matter are subject to evolution and devolution.

It has been shown further that these corpuscles, or smallest bodies of matter now known to exist, are apparently identical with negative electricity, giving rise to the conclusion that matter, at bottom, is electric and dynamic, not inert and dead; what seems its inertia being but an illusion of the senses which fail to perceive its intimate constitution.

The "atom" of hydrogen, for example, is believed to be made up of nearly a thousand corpuscles, revolving swiftly in orbits within the atomic dimension; the "atom" of oxygen of at least sixteen thousand corpuscles; the "atom" of radium of two hundred and twenty-five thousand. The orbital velocity of the corpuscles is estimated

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to be not less than twenty thousand miles per second. It is this enormous initial velocity of the corpuscle, revolving on intra-atomic orbits, that gives the "atom" its hard, separate individuality.

The "atom" is therefore a small solar system, so to speak, of those minute orbs, the corpuscles, a microcosm within the macrocosm; and the amount of energy locked up in their intra-atomic velocities is so enormous as well-nigh to defy computation. As a result of his calculations Lord Kelvin concluded that one grain of hydrogen has within it energy sufficient to lift a weight of a million tons to a height of more than three hundred feet; that a grain of oxygen contains sixteen times more than this, and a grain of radium fourteen times more than oxygen.

Indeed, all our previous conceptions and estimates of energy are so dwarfed by these later revelations of science that one stands appalled by the immensity of nature's resources! Our old-time atom is a veritable magazine of *vis viva*. Here, in the smallest compass, is stored power sufficient to set the industries of a planet in motion.

No practicable method of liberating the intra-atomic energy of the "elements" is yet known. The atoms of several of them, however, radium, uranium, thorium, *et al.*, disintegrate naturally and constantly, being what is termed radio-active, and giving rise to the remarkable phenomena now associated with these substances. Within the next half-century methods will be devised for utiliz-

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ing the intra-atomic energy of matter. Erelong a ton of coal, or oil, or gasolene, will be made to do the work of a million tons as at present burned. Unlimited power lies here under our hands. We have only to learn how to use it, to seam the surface of this planet with the canals of Mars, to maintain genial warmth, to change our climate to the "summer of paradise" and obliterate noxious germ life.

Radio-activity and the resolution of "atoms" into corpuscles have incidentally brought to notice other minute bodies, among these the "ion," so called, which emanates from gas flames and red-hot metals, and carries a charge of positive electricity, in contrast to the negative charge of the corpuscle. The size and weight of ions are believed to be nearly equal to that of an atom of hydrogen, or about a thousand times greater than a corpuscle. The nature and constitution of the positive ion is but little understood as yet; beyond much doubt it is a highly complex system of still smaller bodies.

All the variously named "rays" to which the radio-activity of matter gives rise, viz., Becquerel rays, Niewenglowski rays, Roentgen rays, Alpha rays, Beta rays, Gamma rays, *et al.*, are associated with these exceedingly minute bodies, and propagated in a still more attenuated medium.

Uranium, radium, thorium are demonstrably radio-active elements. But even oxygen, hydrogen, nitrogen,

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carbon, sulphur, phosphorus, may be slowly, secularly perhaps, radio-active, under certain circumstances, as for example when associated in the cell-of-life.

The corpuscles (negative electricity) are the lowest resolution of matter at present demonstrated. But that these minute bodies are the smallest that exist, the ultimate resolution attainable, may well be doubted. It is quite possible, much more likely, indeed, and more in keeping with what has been learned already, that the corpuscle is itself composite, made up of systems of yet smaller corpuscules; and these in turn of smaller still.

Will time and science suffice, indeed, to reach the noumenon?

Is not infinity the co-relative of eternity?

Yet even thus, our theorem of cell life is not affected. For life comes from the life-side of matter, its personal side, its potentially divine side.

Upward from the life-side of matter, the cell has developed as a small personal being, a self, in the midst of the world of unorganized matter. The matter in the living portion of the cell is to a degree segregated from the rest of the universe, its bond to other matter in part disrupted, and new bonds formed within itself. The atoms and molecules thus living together in a cell have formed new relations with each other and broken certain other relations in which they formerly stood toward other unorganized matter.

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What, then, is this new bond of selfhood set up in the cell? In what does it consist?

From the very nature of things we can hardly hope ever to see *sentience* itself, or observe feeling. That would be to pass over from what is naturally visible to sense, to what is naturally to sense invisible; in other words, to expect sense to sense itself. The senses are concerned with things external to themselves. Yet we may hopefully wait to learn more of the process by means of which the atoms of matter stand in vital relations with each other in a cell, how they do it and what takes place in order that this small modicum of matter may behave as a living personality. In the past this has been the great puzzle of biology, the unsolved riddle. Master minds have long pondered it; but they lacked the data which has come from our later knowledge of the constitution of matter.

It is with the sentient side, the self side of matter that life and the personal intellect of man are concerned. Beyond any doubt the corpuscle, or its minute corpuscules, possesses this sentient property in low, undeveloped degree. Each is a minute personality and lives a lowly individual life. When assembled in a certain way, a group of them may pool their individual lives in one, forming of their thousands of small selves one larger self to which those thousands of corpuscles are all subjective, embraced within the cordon of one personal life.

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What, then, is the nature of this bond, or cordon, which is capable of extending the *sense of selfhood* from one corpuscle of matter to another, in such a manner as to embrace thousands of them in one self?

What takes place between these hitherto separate particles of matter, these separate selves, which thus unifies them as one?

Where an appreciable mass of matter is found thus living as a self, a bacterium for example, we have long been accustomed to term the mass "protoplasm," although the word has now little significance. Hitherto we have known nothing of the actual physical relation of one particle of the mass to the others, nor why the mass cohered and gave rise to life. It is certainly a peculiar relationship, not easily set up, since so far as we know at present, undeveloped matter on the earth's surface does not now enter this state, and life is only transmitted from parent to child by means of fission and division of the parent cells; in other words, that life now only comes from antecedent life.

Working from this basic knowledge of matter, our experimentation has been directed to determine what emanations, or "rays," a living cell gives off. It is hardly necessary to say here that such tests are not easily applied. The only fact established is that the cell-of-life gives forth energy of the nature of both positive and negative elec-

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tricity; negative electricity when the cell is in a normal condition, positive electricity when fatigued, distressed, or poisoned.

Nerve currents, meaning the impulses that move along nerve trunks from the brain and cord of animals to muscles and glands, are more easily studied by the ordinary methods. The result of our observations has not been to identify these fully as electric currents, but as electric currents plus other and more subtle emanations. Their comparatively slow rate of motion along the nerve trunks also indicates that a more complicated conduction is involved than that of an electric current through a wire, or other conductor. In a word, a "nervous current" now appears to be a current of negative electricity — since it responds readily to the electroscope — but one either much modified, or bearing along with its component corpuscles a "charge" of something more ethereal.

As to the nature of this charge it would be easy but unprofitable to theorize at present. The only point established is that the cells of the brain and cord generate normally — among other products — a great and well-nigh constant quantity of negative electricity which under certain circumstances changes to positive electricity. What corresponds to electric current proceeds from them quite steadily and they remain as constantly "charged," or surrounded, by a "field" or "atmosphere" of an electrical nature.

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If Thomson, Becquerel, and other eminent exponents of our new knowledge are right, this electrical output from the cell-of-life is nothing else than a stream of corpuscles, and sometimes of positive ions.

Thus far we are on firm ground. Nor will it be deemed a wholly unjustifiable hypothesis, if we conclude that this stream of free corpuscles is generated in the cell by the disintegration of atoms there, since to maintain the cell in bulk and substance, from minute to minute, requires a constant incorporation there of adjuvant atoms from the blood.

Elsewhere in nature, something analogous to brain cell phenomena, is displayed in the phosphorescence of noctiluca, seen at sea, by night; in the fire-fly, and noticeably in the electric eel. The brain cell is therefore not the only generator of electricity and light, in nature. The cell-of-life everywhere gives rise to similar currents of energy.

The phrase, currents of energy, might be held to imply that the cell-of-life acts as a battery cell, or dynamo, and undoubtedly it does. But we believe it to do more than this, that it creates energy in the sense of *willing* chemical action and *instigating* or *directing* corpuscular motion, from the sentient or life-side of matter. Protoplasmic matter is staticly conscious of itself, and motion is the expression of its conscious will.

We by no means wish to be understood here as carrying the idea that liberation of corpuscles in the cell-of-life is

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the only process going on there. The cell is, in fact, a comparatively large organism, if we may be allowed thus to express it. Ordinary chemical action and the formation of carbon dioxide go on in it. What we have described above is rather, as we conceive, what takes place within the protoplasmic molecule than in the cell as a whole. In the cell we have assimilation and oxidation, and also, as we believe, a liberation of intra-atomic energy.

There is much in support of this view. The amount of energy often termed vital, which is generated in animal organisms, has never been fully accounted for when referred to oxidation of the food. It is more than can be accounted for; but physiologists have assumed that it must come from oxidation.

Hence the animal organism has been constantly cited as by far the most economic machine known for the generation of power. Compared with it the best coal-combustion engines are but one-tenth as effective. A pigeon, for example, with but two ounces of seed food in its crop, expends energy in flights of hundreds or thousands of miles, and in maintaining its body heat, vastly in excess of the oxidation of twenty times that amount of food. This has been set down to the utilization of a surplus, stored up in its body in advance, even though no corresponding decrease in body weight is demonstrable.

The chickadee of our northern forests generates in its tiny body an amount of heat, during the long winter

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nights, impossible to account for from the few grains of moss spores which it ingests. Twenty times the heat that comes from its food would seem to be required in zero weather to maintain the little creature's body at 100° Fahr. for fifteen hours of darkness.

But if our present experimentation is trustworthy and our hypothesis from it correct, the puzzle of this great output of energy from the cell-of-life is solved. It is far from being all due to oxidation; it is largely intra-atomic energy. Life in the cell taps the reservoir of energy within the atom.

But how?

How is disintegration of the atom and the liberation of the energy which the corpuscles carry accomplished?

Is it from sentient contact there?

Does this mysterious impulse — the initial, sentient impulse of life — act to break up the iron clutch of death in the atom and set free its living corpuscles, or their more minute corpuscules?

We can conceive no other hypothesis. It is as if, when in this peculiar protoplasmic juxtaposition, the atoms were so placed, relatively to each other, that attractions to and fro, or affiliations, begin, causing depletion of their corpuscles and a liberation of corpuscular energy.

In fancy, at least, we may sketch this, and picture what goes on when the corpuscles of the component atoms in "protoplasm" are liberated, to form outward-flowing cur-

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rents and that aura, or "field," which is necessary to enable two or more cells, a million or a billion, to live together in one personality. For we may be sure that this pooling of separate cell lives in one greater life — the human personality for example — has a physical basis. At present this basis seems to be a reciprocal confluence of corpuscles, or their more etheric corpuscules, first from atom to atom, and, in larger volume, from cell to cell. And the energy, thus liberated from the corpuscular velocities, constitutes, not life itself, but the will-power with which life acts.

The bearing of this hypothesis on the problem of cell preservation and cell restoration in the human organism will scarcely fail to be apparent. If verified, it would prove a long step toward our hoped-for control of life at its sources. It is but hypothesis, however, at present, and nothing more is claimed for it, until further proof is obtained.

What we do claim as established by our experimentation is that the brain neurons in the exercise of their function of stimulating and actuating the subordinate tissue cells of the organism, generate and emit a flow of corpuscles of the nature of electric currents.

On the other hand, certain physiologists contend that the nerve currents which emanate from the brain originate solely in the oxygenation of the blood, and that the greater relative amount of electricity within the cranium is

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accounted for by the greater relative volume of blood which goes to the brain.

We are far from arguing here that even this latter contention may not contain its modicum of truth. Nature has this constant trick of mixing effects from her agencies; and nothing is more erroneous than ascribing concrete effects to single causes.

Nor do we assert that a more minute attenuation of matter than the corpuscles is not present in nerve currents. But we are now able to prove that a tide, or "atmosphere," of corpuscles is present in the brain; at this stage of research we can speak positively of no other.

Around and throughout the affiliated mass of brain cells there is a swift "circulation," so to speak, of the emitted free corpuscles, comparable to an eddy, or vortex, ensuring practically instantaneous, reciprocal action of cell on cell; so that the whole assemblage of neurons is instantly unified in one consciousness, to wit, the human personality. Within its containing walls of bone and membrane, the brain is charged and electrified by this scintillant aura of free corpuscles which fly to and fro with the velocity of light. The mazy arborizations of the neurons — their interlaced fibrils, making protoplasmic contact — facilitate the process of sentient unification and have plainly developed to this end. But it now appears to be the swift circulation of the corpuscles which is the

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immediate agency for pooling the separate cell lives in the one greater life of man.

Moreover, this circulation or scintillant eddy appears to go on around a center, or axis, which we have elsewhere termed the personal axis, or axis of self-consciousness. It is akin to the "circulation" of corpuscles (electrons) which goes on around a magnet.

Keeping to the firm ground of what is proven concerning the constant out-put of corpuscular currents from the brain, and its residual charge, or aura of the same, it may be definitely stated, that this is the key-note to metazoic life, the agency by means of which the brain cells actuate and control the organism. The paramount importance, therefore, of keeping this agency constant and normal becomes apparent. Many, in fact most, of the ills of advancing years start here and are due to slackened tension of the currents and weakening of the corpuscular aura.

This, it may be said, is an unavoidable concomitant of old-aging. During adolescence the tissue cells grow forward to the organic dimensions, cease growing when the type limits are reached, and pass thereafter into the stasis of adult life, yet retaining for fifty years or more the capacity of further growth for organic repair, if from accident a demand is made from it. But even by the end of adolescence certain restrictive causes have begun to inaugurate organic decline. The organism, at first so fresh, clean-tinted, and plastic, shrinks, chemically hardens, and

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wastes at a thousand points. Growth having stopped, the cells fall into a condition of desuetude and dormancy from which they are only roused by some urgent need of the organism, as from a wound, or a broken bone.

As the time-effects on the organism continue and the hardening and shrinking of the tissues go on, the cells are not only desuete and inert, but become encysted, smothered by their hardened products and lose the opportunity, if not the potency, to live longer. They die out in skin and bone and muscle fiber. For nutrient particles from the blood no longer reach them freely through the shrunken capillary tubes; nor do the toughened, hardened nerve fibrils transmit freely, as in youth, currents of incitation from the brain and cord. They are insulated from the actuating neuron, isolated from each other and lose touch with the rest of the organism. Hence they slowly die out. Such is old age.

Yet we must ever keep in view that all this is due to ordinary, mechanical causes, such as are within the province of science to deal with and remove. Nothing worse, more final, nor more esoteric.

We must also keep in view this other fact of human physiology, namely, that owing to the growth of knowledge, and hence the coming of larger interests into human life, with greater ambitions, brain has become a progressive tissue of the human body. That is to say, much more so than muscle or bone or any of the other associated tissues

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or groups of cells. Brain is the cell group which is now leading off in human evolution, drawing the other groups after it. The human brain would now live two centuries instead of one, were it not dragged down to death by the growing infirmities of the inferior tissues.

With the incentives and opportunities which modern life now offers, there is, in fact, almost no limit to the lifetime of the brain neurons, if only the rest of the human organism held out and was equally progressive.

Equally, too, and less hopefully, we have to reckon with that other fact that these very incentives to brain evolution have disturbed the natural balance betwixt brain and the inferior tissues; that modern life, especially in America, tends not only to develop brain, but to repress the development of the rest of the organism and enfeeble it. In a sense the strong incentives to brain activity and brain growth monopolize the vitality of the whole organism. Hence we constantly see persons, men in the heyday of intellectual life, cut off by the bursting of a blood vessel in the brain, failure of the renal or hepatic tissue, or a breakdown of the alimentary tissues. The fundamental reasons and causes of these disasters must be kept sharply in mind, in devising rational systems of self-conservation.

As prefatory, too, we must again call attention to a premature deterioration of the brain cells in ninety-nine out of every hundred adults in America, from lack of good

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habits of resting them. Ninety-nine out of every hundred of our people, as middle age is reached, drift into bad habits of sleeping, resulting in insufficient brain rest from day to day and year to year. The neurons shrivel and become wizened from worry and lack of normal rest. This is the physiological fact, and the physical aspect which examination reveals: to wit, prematurely shrunken, blighted neurons.

On the psychic side we have the well-known joyless mental condition, the haggard, hurrying mind, with scarcely a smile on the face; the type one sees on the streets of our great cities. Instead of a pleasurable process, thinking appears to have become a pain, a hot, tremulous effort of cell activity.

Under continued pressure of business, the goad of ambition to attain wealth, the miscarriage of plans, or the dread of financial disaster, the brain cells go on for months, and even for years, never once normally rested, refreshed, or freed from the incubus of worry. Often there is insomnia, inducing a condition of anguish from which suicide is a blessed relief. Unrested neurons may come to that bad pass where life is a torture and the personality that rises from their combined sentiences, so much condensed wretchedness.

Such a life is not worth living, but the victim does not well understand the causes. Generally he takes more coffee and tea, or resorts to whiskey, chloral, morphia, *et*

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al., all of which adds to the misery of the unrested, overwrought neurons that uphold his self-conscious life.

Unless properly rested, this congeries of cell life within the brain cannot be adequately nourished from the blood. There must be sound, normal sleep, allowing these cells to cease from their corporate labor and free themselves from the unremoved waste products of waking life. That is what sleep means; that is its object under nature. These at-one-time protozoons, now affiliated in a brain, must revert to their erstwhile unicellular life and live it again, separate, for eight or ten hours daily, to restore and refresh themselves for the great task of producing the human personality for another day. For them it is a true labor of Hercules. So heavy a labor, indeed, that it must be intermitted regularly and patiently;—but our exigent American life often garbs them with the shirt of Nessus!

The sense of mental comfort, well-being, and personal enjoyment can coexist only with well-rested, well-nourished brain cells. The cells — each a living creature — must be comfortable and happy in their small lives, in order that their consentient union in the human self-consciousness may be a happy one.

Disturbed sleep, beset by dreams, but illy rests the brain. One has only to examine the arrangement and relations of the neurons to each other — their fibrils, their tentacles, so to speak, for united activity — to understand what the physiological basis of the personality is and see the reason

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why sleep is so necessary. It seems to be a case of making and breaking contact. The pooling of the cell lives ceases when we fall asleep. The elate, erectile condition of the cell fibrils sinks down; the whole brain occupies less space in the skull; on the part of the neuron there is a reversion to unicellular life. The onerous nature of the united or personal life renders this imperative.

Experiments with electroscopes show that fatigued brain cells yield diminished currents of nervous energy. There is sub-innervation, also unequal innervation, some organs and apparatuses receiving more nervous stimulus than others, the solar and lumbar plexuses appreciably less. In passing, it may be remarked that this latter observation falls in with the frequent manifestation of renal disease in organisms nervously depleted.

It is, indeed, not only remarkable but ominous, how little disturbance in innervation from the brain and cord suffices seriously to impair the organic harmony. Sub-innervation of the organism also opens the door to microbic attack, and of non-resistance to sudden chill, which induces pneumonia and other maladies. Tired brain cells naturally crave narcotic and alcoholic stimulus, where well-rested cells would feel no such craving. Normally rested neurons feel no appetite for alcohol, coffee, and tobacco, rather a revulsion; nor yet for morphia or chloral. These all may be termed, not inaptly, the jaded neurons' "desperate refuges," so many proofs of sub-innervation.

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Still further, it is demonstrated, that the person with jaded neurons is different mentally and morally than on occasions when these cells are normally rested. Following brain fatigue, character sinks to lower levels; the person is less optimistic, less resistent to temptation to evil courses; there is less of "soul." The sub-innervated person almost invariably takes dark views of life, lapsing insensibly to pessimism. Normal innervation from rested neurons is therefore a question of public morals. The tired brain reverts to savage instincts and grows insentient to the call of mercy, honor, or truth;—as witness the frequent exhibitions of ruthless savagery, trickiness, and relentlessness at the "Wheat Pit" and Stock Exchange. One has but to walk the streets of New York and other large towns of America in times of financial excitement to see the faces of men who are going back to savagery by leaps and bounds!

But the remedy?

At the present stage of our knowledge, but one line of advice can be given.

Whatever the circumstances, whatever the seeming necessities for going on, whatever is at stake, stop short and rest those tired cells. Any loss is preferable to the loss of your "soul" by reversion to the far-off brute from which, by so long a labor of evolution, we have arisen. Stop short. Stay abed. Sleep.

Sleep may not be easy where long-standing fatigue and

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stimulants have been at work. But keep abed all day. If insomnia and throbbing cerebral arteries drive you up to rush to and fro, do so for the time, if you must, but return to rest and persist in it until you sleep long and well; and the calm, rested feeling of your young days returns to you, with comfortable sensations, gentler, nobler sentiments and cheerful, hopeful views of life. They will come back to you, if you stick to your resolve to sleep ten hours in a night, for a week, or a month. But get it back. Save your soul from that hell of unrested brain cells. You are a "lost soul" if you can not. There is profound wisdom in the slang of the Western drummer who counseled his tired comrade to —

> "Beat it home and hunt the feathers,
> Take a good long snooze."

The effort is worth while. It means the return to normal mentation, the redemption of character, the elevation of judgment, the purification of thought, the lustration of intellect. In a word it means self-salvation.

If a battle has to be fought with stimulants, it is of the greatest importance to sleep much and keep well rested while the struggle is made. Even in cases of inveterate habit, the craving is less when one sleeps a good deal and brings as little stress and strain as possible on brain and nerves.

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With this preface, I shall attempt, though not without diffidence, to outline a method of brain-cell husbandry, which I believe will give gratifying results to those who have faith and patience to practice it. It will never, as I am painfully aware, prove a popular panacea, since it calls for self-effort and self-control, and does not humor the inveterate human propensity to swallow a large "dose" of something, and then wait for internal wonders to be performed. It is doubtless true, too, as often alleged, that our average contemporary does not care enough for prolonged life to make a sustained effort to live, but prefers the pleasures of food, drink, sex, dress, and recreation of a type better described as dissipation; in a word, for the purely animal pleasures which go, physiologically, with a short lifetime; that mode of living which inevitably runs the organism down in sixty years, or less.

Of the higher joys of living and looking forth on the infinite, life-bearing universe, with the sublime sense of growing in knowledge of it, there is, as yet, but little appreciation. The brute in us has but begun to look up fitfully from his daily prey and feel the mind-stir of those diviner joys.

Many, too, are so pitifully chained to the wheel of modern civilized life that they have not, or think they have not, time for anything save their daily task. Tired or rested, they must plod the tread-mill — or think they must.

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So that it is to few only, a few hundreds, or a few thousands, that my present method of prolonging life will commend itself.

Briefly, it is a method of conserving nervous energy in the cells of the brain and cord; that is to say, carrying a greater residual charge of such energy there, a fuller "head" of vim in the brain. *Vim* is a good and well-derived word for it. *Mettle* not as good. In the phrase of the ancient Greek stadium, it was *ichor*.

We are not here regarding the brain cells merely in the light of a storage battery, although the galvanometer shows that they carry a considerable residual charge of electricity which may be increased or diminished.

In healthy adolescence, too, and in exuberant young adult life, potential often accumulates in these cells to a degree markedly exhilarating, beautifying the whole body, giving abundant evidence that such augmentation of potential there is possible and natural; — although youth as a rule immediately squanders it, in excesses.

Augmentating it is an art which has to be learned from practice and habit, the first almost irresistible tendency of the untrained person being to dissipate the increase of potential, as soon as he feels exhilarated from it. Training and practice will alone ensure self-control in carrying a fuller residual head of vim.

Incidentally, it may be remarked, that nothing is more

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universally common than the frittering away of nervous energy in aimless, semi-involuntary activities, the least heightening of nervous potential being sufficient to set the person off in various ways. The first efforts, therefore, to raise a head of vim almost invariably result in muscular, mental, or sexual excess; the animal impulses run away with the neophyte; he has not yet got himself in hand; and some perhaps could never acquire sufficient self-control. Practice and *a realization of the object for which he is working*, will at length found the habit of self-retention.

This, however, is not the task of a day; six months or a year may be required for it; — but the result, when attained, will be found worth the effort. The personality will be found to have been raised to a higher plane of intellectual life by the achievement.

It is not easy to give a rule or rules for such self-control; temperaments differ greatly; but the principle of it lies in keeping the object aimed at constantly in view, steadying the mind by proper reflection and pulling one's self up short the instant that undisciplined impulses are felt. And for a time these tendencies will be found insistent and importunate — the tendency of the sleek, well-fed horse to prance and bolt. But he who would conserve and prolong his life must resolutely check such instincts and form a habit of ignoring them. He must steady himself, hold himself in hand and apply the hard brake of his purpose to his vagrant propensities, realizing that in so doing he is

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preserving his personality, conserving his life, saving his "soul."

This great art of prolonging life has yet to be acquired by human beings. It will come only from mental discipline and mental evolution. It is a regimen which can be enforced only at the call of a higher life — the greater life of the intellect, with its better joys, the life which outgrows the animal in us and leaves brutish propensities behind.

If asked to describe in what this head of vim consists, or explain what it is, I should have to say that, aside from the electrical charge which is embodied with it, we do not know. It is electricity plus something else more ethereal which we know as yet only by its vivific effects on every tissue of the organism: it is the true elixir of life. It is vivific matter which invigorates and holds in closer, sentient union every component cell and every intracellular molecule in the organism. So long as this vivific tide can be generated and a head of it maintained in the brain and cord, there will be no death; it is death's antithesis.

This full, sustained head of vim when held in mental control, tends to diffuse itself slowly along the nerve trunks and fibrils, to every muscle, gland, and tissue cell of the organism. It reinforces and holds all together in a sentient entity, around the axis of personality. It heightens sensation throughout the body, renders the special senses

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more acute, and adds perspicacity to each mental concept. It makes the person more vigilant, more careful in danger, more clearly discerning, more moral, that is to say normal, in his relations with his fellow-men.

Furthermore, a full, sustained head of vim in the organism is the best of insurance against disease. Barring a few of the filth diseases and contagious diseases, an organism surcharged by nervous energy is practically immune, and often moves scot free amidst contagions.

Advancing from this consideration of the facts, we come logically to look for some method of regulating, conserving, and applying this greater head of vim which the cells of the brain and cord place at our command, some method of using it rationally for improving and lengthening our lives, instead of allowing it largely to run to waste, as is now the case in most human organisms.

It should be possible to devise some practical method of self-renewal, or at least of self-maintenance, from this fund of vivific energy which nature yields us, some method of reversion and restoration.

This, of course, is an effort, or an art, which is still in its first incipiency, never before attempted, on a set plan, with such an object in view.

Before attempting to outline so novel an effort and put it in the form of a method, let us consider two well-established facts. First, that the cell neurons of the brain and

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cord are capable of generating, and, in ordinary life, do continuously generate, a current of nervous energy which, in electrical terms, is equal to half a milliampere at a very high voltage, since it has the effects of light. This may be set down as the energy-producing capacity of the brain, used ordinarily in mentation and the instigation of muscular and glandular activity.

Second, in our study of the various forms of life throughout nature, we observe that the cell-of-life has in it the power to turn its stock of energy to almost any purpose which its needs demand, and transform that energy to other modes, even to effect chemical changes. For example, as cited above, the firefly and glowworm produce light at will; the gymnotus eel, electricity, the rattlesnake, the cobra, and the adder, deadly chemical combinations of matter.

While it is true that the light-producing and the electricity-producing cells of photuris and gymnotus have been a long time developing to their present condition, it is none the less true that they had to make a beginning and that this beginning was made from sentient impulse. Also that the weak cell impulse of insect and low animal life is as nothing in intensity, compared with the will-power of a human being.

In these and numberless instances we see what the cell has actually done with its potential. It teaches in a general way what transformation can be made and what

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chemical changes in living matter can be accomplished, when backed by the will.

It is after an examination of these effects, produced under nature, in the course of life on earth, that we have ventured to outline the following method of using the potential of the brain and cord for self-restoration.

First of all there must be formed a fixed resolution, followed by an effort of the will, to turn the current of vim to a particular use, — as when the gymnotus *wills* to give an electric shock, or the firefly to produce a flash of its light. Nature shows us that these things can be done by *willing to do them*, that is to say, willing chemical changes in the living substance of the cell. And here it may be remarked that all the "mind-cures," "faith-cures," "Christian-science cures" and others, are so many purblind attempts to make use of this innate power of the brain cell for curative purposes. But thus far these efforts have been so linked with supernaturalism, or charlatanry, as to lose much of their effectiveness. It is still a babel of incoherent cries.

Self-restoration, as set forth here, founds on the facts of scientific research, but requires scientific training to put in practice. We can demonstrate the existence of this current of nervous energy, as also its preservative, curative effects on the organism. We have it at our disposal and have learned that it can be accumulated in the organism

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by skilful culture and husbandry of the brain cells; and we observe throughout nature what *will and sustained purpose can do with it.* In the light of our growing knowledge of nature and life, it is now our purpose to utilize this great vivific form of the universal energy, put it under intelligent control, and use it remedially.

But what is the method of application?

An answer to this question introduces a kind of effort, or exercise of self-control, which is both new and novel to mankind. And because novel, many will, of course, exclaim that it is impossible. In very truth, it demands that the *debutant* practice a purposive effort, by will-power, such as human beings have never hitherto attempted upon any set plan. When done in the past, it has been sporadically, without purpose or plan behind it. It is a new use of nervous energy and the human will; and first efforts, too, are always crude efforts. Hence it is with diffidence that a *modus operandi* is suggested. Yet the writer fully believes that it can be done, and that once begun, increased facility will come from practice.

For the neophyte the first suggestion would be, rest your cell neurons until you feel that you have a full head of vim in the organism, even if a week or a month is required for it. Rest and recuperate until you are in the best condition possible. This is the necessary first step, the *sine qua non:* a head of vim to work with.

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Then let us suppose that you wish to bring this head of nervous energy to bear on the lower dorsal and lumbar region, "the small of the back," where fibrils from at least sixteen pairs of the spinal nerves lead to and connect the brain and cord with the sympathetic system of nerves and ganglions, which supply and control the abdominal and pelvic viscera; the liver, kidneys, cyst, *et al.*

This region is first mentioned because it is the one which, in nine persons out of ten, is the weakest portion of the organism, the one most in need of curative innervation. Here the brain has many of its connections with the "vegetative system" of the organism, so called, which acts for the most part automatically and independently of volition.

For, as all students of anatomy and physiology know, the human body consists of two distinct sets of organs, or apparatuses: first that of self-consciousness, thought, will, special sense, muscular activity and locomotion, meaning the brain, cord, eye, ear, muscles, bones and their appendages; and second, the organs and apparatuses of food preparation, assimilation, circulation, excretion, etc., namely, the stomach and intestinal canal, the liver, pancreas and other glands, the spleen, kidneys, etc.

The aspect presented is that of a double series of organs and apparatuses, presided over, each, by a different system of nerves and nerve centers; to wit, the brain and spinal cord for the first, and the sympathetic system with

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its many ganglia, including the solar plexus, the semi-lunar ganglion, the hepatic ganglion and others, for the second.

In the early days of anatomy, it was believed that these two nerve systems were wholly distinct and without connection one with the other. But we now know that, although essentially different systems, the two are associated by means of numerous small nerve fibrils, through which the self-consciousness and will of the brain may, to a degree, act on the sympathetic system and influence its operation. It is in the lower dorsal, lumbar, and sacral regions that the connection is mainly accomplished, and here, therefore, that the will can be brought to bear on the organs of digestion and excretion.

Given, then, your accumulated, conserved head of vim to work with, seat yourself comfortably in an arm-chair, and place the hands and forearms on the "arms" of the chair, in such a manner as slightly to support the body weight on them. (This or any other posture that appeals to the individual preference.) In this position concentrate the attention on the small of the back for five seconds, summoning the will ready to act. Then by a muscular effort retrovert the lumbar vertebrae, backward and upward, thus increasing the flexure of the spine, and by a sudden strong exercise of will-power, cast nervous energy into those tissues.

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We may use the word *energize* for the act. Energize those tissues. *Synergize*, however, is the better term, since the act results from a combined and reciprocating effort. The act itself may be properly defined as a *synergy*.

It is best accomplished by a series of efforts and synchronous retro-flexures, six or eight efforts, let us say, during a minute, to be repeated two or three times after an interval of rest, daily, or night and morning.

For some reason the backward and upward muscular flexure of the spine aids the process.

Many persons catch the knack of doing this immediately; others find it difficult and have to practice it at intervals for a considerable time; and there are those, perhaps, who cannot learn to do it, through some insufficiency of volitional power, or deficient nervous connection between the two nerve systems.

In one case, I have known the art to be acquired suddenly after repeated failures. For it may be remarked here that there will be no doubt or uncertainty when the act of transmitting nervous energy is really done; that is, when the effort of willing vim from the cord into the sympathetic system is actually accomplished. It will be felt to go.

It is the writer's opinion that this act, or art, can be attained by practice, and accomplished much more effectively by continued practice, so as to become a step in the progressive control of the organism by will-power.

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For brain is a still progressive tissue of the organism, and has possibilities of future evolution and growth which look to the complete control and maintenance of the organism in function, through indefinite periods of time. We mean by this, that the brain shows capacity to grow into a much larger, more powerful organ, able to generate currents of nervous energy, or vim, which may be directed to the restoration of all the associated organic tissues. Our nascent "art," or method, as sketched above, is therefore strictly in line with the entire scheme of human evolution and natural salvation.

Direction and application of nervous energy, by will-power, to the lower dorsal and lumbar region, is suggested as one *point d'appui* of it merely. The vivific energy can be applied equally to an arm, a leg, the lungs, or even the heart; to any tissue of the organism. Rest, nourish properly, conserve nervous energy and use it remedially, purposively, on the organism, by will-power, under the intelligent direction of the mind, that is to say, *a clear mental concept as to what is to be done with it.*

We are not here dissenting from a skilled use of drugs or other remedies for bringing the organism into harmonious action. Every adjuvant agency should be used to this end, when such use proceeds on an adequate knowledge of the subject. We believe vim, as above defined, to be a current of corpuscles; and it may be, of the ether

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itself, modified by the will, changed in frequency or otherwise, in a manner to accomplish what the impelling intellect and will, resident in the cerebrum, desire. Chemical modification of living matter by sentience and will is in fact the oldest thing in nature, seen in the thousand phases of insect and animal life. It is the key-note of metamorphosis in all metazoic life. This, indeed, is the principle on which the method founds, namely the domination of mind over protoplasmic matter, by will-power. It is assumed that the human will, by trained, persistent effort, is strong enough to produce transformative effects in the protoplasmic matter of the tissue cells.

Ordinarily, as the average human being lives, the currents of nervous energy from the brain and cord go to accomplish locomotion, muscular contraction, and the usual activities of life. When not used in this way, it is diffused, often dissipated, without thought or intelligent direction. In healthy subjects, it goes, at a certain tension, to maintain the corpuscular "field" or aura, which stands for the person's vital tonicity, or "constitution," and is closely correlated with his character and morals.

At the present stage of human evolution, physical and intellectual, this is wholly or very largely sub-conscious, and in that sense, self-acting.

What the present system of self-conservation and self-maintenance aims at is to promote and foster the potential out-put of nervous energy from the neurons, by rest,

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correct living, and careful nutrition; to husband it in the brain and cord; and to use it methodically, to maintain and restore the organic tissues.

In this sense the present suggested method is a new departure in bio-physics. It attempts to educate the will to a higher degree of efficiency, as a director and transformer of nervous energy.

It is perhaps too early in the progress of this art to speak of facilitating or aiding the action of the will in throwing nervous energy into the organic tissues, by use of extraneous currents of electricity, generated outside the brain, and applied to the spinal cord. Or, indeed, of schemes for uniting the will-power and nervous energy of five, ten, twenty, or more persons, to act synchronously, in combination, for healing the sick. Beyond doubt this may be done and remarkable curative effects produced, as soon as we can devise media and apparatus sufficiently delicate to combine the nervous energy of many persons in a single current or impulse.

We are still at the beginning of using will-power rationally, in combination. Its great future is all before us. Yet even in ancient days, we learn of untaught attempts at healing the sick by united prayers on the part of many devotees gathered together. In cases of sudden panic, too, affecting great crowds of people, and also at popular religious assemblages, we have evidence that the violently excited nervous energy of hundreds of persons

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sometimes combines or coalesces, spontaneously, to produce wild, overwhelming effects. Such manifestations rest on a physical basis, beyond question. Hitherto this has been wholly within the realm of superstition; but it offers a proper field for scientific investigation and promises very hopeful results for the control of life. There is no good reason why the will-power of a thousand persons may not be united in one volume or current, and directed to act remedially on the organism of a single patient. Experimentation of this kind, having in view combination and transference of will-power (vim) is already going on at this laboratory.

I am fully aware that many who glance at this suggested "art" of self-conservation will say, "Nonsense! This is trying to lift one's self by the boot-straps!"

But try it, my Thomasian, try it fairly, earnestly, for two weeks and see. It runs deeper than you think. Will-power touches down to the lower, self-motile levels of matter and is of the nature of transformative energy there.

Others will say, "You are making the brain cells restore the other tissues of the organism; but what is to restore them? You can not get nervous energy otherwise than from your brain cells. If you use up their capacity to generate vim — as by your method — what will replenish it or restore the personality at its source?"

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Passing over the physiological fact that the brain-cell group is the most enduring tissue of the organism, also that it is the best nourished, the last to perish in cases of famine and starvation, and in general the most vital and the longest-lived; passing these considerations, we come to the higher, psychic truth, that in the hope and reasonable certainty of longer, happier life, we have a replenishing agency. Hope or faith that we may live longer, happier, more successfully, affects life at its source and strengthens its upward correlation from the lower planes of elemental sentience. In this it is as when one increases the height of a chimney for combustion draught; the ascending current of air is rendered swifter and more powerful. Alexander Pope possessed more than poetic prescience in the mysteries of human life, when he sang,

"Ah, happiness, our being's end and aim."

Life, meaning the elemental sentience of unorganized matter, struggles upward through the mazes of protoplasmic organization, to attain greater intelligence, greater happiness. To this psychic end, "creation groaneth and travaileth together"; and whatever extends the hope and promise of more life and happier life, increases the intensity of life in the protoplasmic substance of the brain cell: in other words, replenishes it at its source. It is the hope of achieving immortal joys which will carry us forward to the great attainment.

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Let it be stated again, that this art or method is by no means put forward as a radical cure for "old age." We have control of no such preventive agencies, as yet.

Will-power can be applied to some purpose for conserving and prolonging life, but is not yet sufficiently potent in man to counteract those profound physiological changes which now go on in the cell from adolescence to senescence. To arrest and check these changes, we have yet to devise a method of "corpuscular nutrition" for the cell-of-life, in place of the present imperfect and foul food-nutrition. In other words, we have to get control of the nutritive economy of the cell, and supply a chemically pure food; and also perfect a method of intensifying cell life in any and all of the organic tissues which need intensified vital action to keep them normal and in harmony with the associated organs and tissues.

The new knowledge of matter goes far to pave the way to these discoveries; in truth, we feel that we are on the eve of such inventions. Once in control of the cell-of-life, able to direct its nutrition and stimulate it to renewed activity, the problem of deathless life is in our hands.

Deathless life!

Who would want it?

Few of us, indeed, with our present low ideals, our present tiresome routine of sensory pleasures!

But there is a higher life which every human being catches glimpses of, at times, and feels the nascent capacity

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for. Toward that higher, happier, naturally immortal life, we are slowly rising. But ah, so slowly! And that, too, when we might advance to it so rapidly, if only the right ideas could gain place and prevail!

As yet we are but at the beginnings of life-science, taking the first feeble steps at learning to live. To live for longer periods, for centuries, let us say, we require greater incentive, greater vital stimulus, than comes from our present brief, half-painful life-pleasures. Incentive to live after the sensory period of adolescence and reproduction has passed, is now what is wanting to most of us; that strong, ennobling incentive and stimulus which come from living our lives in harmony with the larger life of the race and consecrating ourselves to its interests.

The personal lives of men are as yet but imperfectly organized in the greater life of the race. Humanity is still much like one of those rhizopod colonies which we see in warm ditch water, not yet organized in metazoic life. We are still but loosely associated with our fellow-beings, not united with them, as are the cells of the animal organisms. We have not yet begun to live fully in the larger life and find joy and strength in it. We still but faintly feel the pervasive sweetness of that absorbing race-passion, that abandon of self in the larger life of mankind, which thus far only one of the sons of men seems to have fully felt, and that nineteen centuries ago. His scheme of immortal life is not yet much understood. But thanks to our re-

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searches at the heart and core of protoplasmic matter, we begin to preceive what the "Kingdom of God" may mean and how we may enter into it.

And that other great diviner of natural truth, Siddartha; — what he meant by his hitherto enigmatical *Nirvana:* the personal life, put in harmony and rhythm with the universal life.

Natural Salvation seeks to establish on a scientific basis, supported by physical data and appliances for realization, what these and other great diviners of truth saw from afar, in the past.

For ever and always, we live because we have something to live for; and the final, grand incentive to live deathlessly, will come to those who identify their self-lives with the potentially deathless life of mankind, enter with zest and zeal into its greater ideals and ambitions, and make themselves part and parcel of it.

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COMMENT AND DISCUSSION.

SINCE the first editions of *Natural Salvation* were published, a number of reviewers and critics have described it as "an attempt at a new religion," "a new cult of Nature," and, generally, as something newly devised.

It would have been better described as the oldest of all religions, the religion of cell life, the instinct-effort of the protozoon to save itself. Compared with this natural effort at salvation, on the part of the unicells of the ancient earth, the World's five Creeds are as novelties of yesterday. A hundred millions of years ago, natural salvation was operative and prevalent; it is coeval with the earliest metazoons; the first cult of unicellular life; the "golden rule" of the cell. The golden rule of Christianity, indeed, is reflected upward from it, upward from this lowly sentiment for union and cooperation on the part of the component cell life of the body.

"An opponent," thus styling himself, asks, with a flavor of derision, "Do you actually believe that the protozoa, the unicellular life on the ancient sea beaches,

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united of their own accord, as sentient creatures, to form the metazoa, and that the human organism, the human brain, has resulted from a plan or design on their part to better themselves and rise in the scale of existence, looking to cell immortality?"

The answer is, no; nor has any such position been taken in *Natural Salvation.* We do not know how or why cells combined, whether by accidental cohering, or because they derived some immediate advantage of safety or food by keeping together. We have no more supposed that the combining unicells had a far-reaching design, or foresaw the results of their unions, than that the individual locusts of a swarm foresee the famine that may follow its flight; or that the individual *hoplite* under Xenophon, who marched with Cyrus the Younger, foresaw that this immortal expedition would open the way to the victories of Alexander and the third great empire of antiquity.

We do not suppose that the unicell of the Silurian beach foresaw its apotheosis in the brain neuron of a Webster, a Washington, or a Lincoln. The cell but chose to do what *felt* best for itself; or it may even have been coerced to what it did by the merest accident of its environment.

It would neither add nor detract from our present estimate of the impersonality of cosmos, were we to learn that all the metazoons, including mankind, started from

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the accident of a few grains of sand falling foul of a cell, a hundred millions of years ago. We have given up the idea of design in Nature to that extent. Nature neither lets nor hinders; the liberty of cosmos can in no other way be conserved. Why speak of design? Nature needs not design.

With greater justice one of the associate editors of the *American Journal of Science* calls attention to the fact that the cells of polyzoa — *bristadella mucedo*, for example, cited on page 28 — are more fully organized than I have seemed to describe them.

This is a deserved criticism, and I am glad to record it here. At this late age of the earth's vital history, it is not easy to find illustrations of early metazoons. None the less, we would be slow to believe with the elder Agassiz, that all the present metazoons were "created" as we behold them. *Bristadella mucedo* was cited in this connection, not as being one of the early simple unions of unicellular life, but merely as resembling externally, perhaps, what these early unions might have been like.

The point really at issue here is whether the metazoons developed from unicells, or that the tissue cells of the animal organism form, multitudinously, in this same organism after it was otherwise created. The former position is the one held in *Natural Salvation.*

A reviewing editor writes to ask, "Is this natural sal-

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vation idea of yours the same thing that Metchnikoff and Loeb are working on?"

Professor Metchnikoff, of the French Institute, believes that by means of reagents of the nature of serums, so called, the tissue cells of the body may be so reinforced, that human life can be greatly prolonged. He holds that "old age" is accelerated by the abnormal activity (phagocitosis) of the white corpuscles of the blood, which, after a manner, devour the cells of bone, muscle, brain, and other tissues. Experiments are now in progress at many European laboratories, bearing directly or indirectly on these theories. Facts of great interest have already been brought out.

Professor Loeb, of Berkeley, Calif., holds the theory that life can be initiated artificially by chemical agencies; he claims that fertilization of the ovum can be thus accomplished chemically in the case of the sea-urchin, without sexual union. If fully established, this fact will be of the highest importance.

The present writer does not know what Professor Metchnikoff's or Professor Loeb's views or beliefs are, touching immortal life for human beings, nor whether they believe their discoveries have any bearing on the subject.

Another critic, a venerable teacher of theology, writes in pained surprise: — "Natural salvation! How can salvation be natural? Nature dies. Salvation is from God

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and his Son. Salvation is above nature. It is supernatural. Natural salvation is a contradiction in terms — a self contradiction!"

What a picture do these words portray of the indoctrinated, dogmatized condition of this man's mind! Salvation a supernatural rescue at the hands of a supernatural being. Otherwise incomprehensible.

This, indeed, is the conventional, church attitude of mind, the attitude which regards the "soul" of man as a "spirit," detachable from the human body at death, or, indeed, in trance, or catalepsy; a spirit to be saved by Divine favor or grace, divested of the body and unincorporate.

It is this conception of life which the growth of scientific knowledge invalidates; and to me it seems only logical that theologian, priest, and sectary should oppose scientific progress generally. Science wastes creeds as the warm spring torrents melt the ice of winter. There is no way of chaining humanity to a creed, except by arresting its mental growth. This latter is what Catholicism in America seeks to accomplish. Its sustained struggle against popular education and the growth of knowledge here is one of the most instructive spectacles which the times present. There is, indeed, no other way of perpetuating creed and its establishments, except by laying the spell of church authority on the brain, and effecting a semi-paralysis of this troublesome organ of progress.

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This is the long-existent condition in Mohammedan countries. This is what the Christianity of Rome and of Constantinople have at times accomplished in Spain, in France, in Ireland, in Russia.

It is quite impossible to harmonize Judaism, Mohammedanism, Catholicism, or Protestant sectarianism, with the growth of human knowledge and the progress of scientific discovery. The obstacle is something more than the mere fact that science invalidates certain dogmas of the church. It is rather that the mind of the scientific student outgrows the crudeness and the injustice of the creeds. Normally, naturally, the world grows away from them. Moreover, between church doctrines and the science of our times, there is an issue raised, a crucial question, this: —

Is the human personality, the ego of a human life, detachable from the organism, capable of living on in the absence of that organism, or not? Church authority says yes, the growth of scientific knowledge, no. A grave question of veracity is thus raised. One or the other is radically wrong.

It is the realization of this *impasse* which accounts for the present attitude of the scientific world toward the church; the attitude of quiet tolerance, with a disinclination to discuss the matter; the realization that the church has its uses and is endeared to a large class of the population; the further realization that the regimen it prescribes,

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is perhaps best for that class; and, finally, the thankless nature of the task of teaching truths which would be certain to be unpopular. Briefly, the biologist of to-day is shirking his duty as a teacher rather than incur odium and resentment.

"Your contention is unique to say the least of it," another critic writes. "So far as I am able to follow your reasoning, you fail wholly to distinguish between physical and psychic powers. You treat them as if of common origin, as if there were no essential difference between them. This to me is chaotic and would subvert psychology. You confound sentience with the insentient forces of matter. You make neither distinction, nor difference, between them."

There is no difference, that is to say, none as to their ultimate source or origin. There are no "insentient forces of matter." Matter lives, that is, feels, and moves, because it feels. Indeed, there is no such thing as matter, in the former sense in which the word was used. Matter is energy and is sentient to us when it is embraced within the symbiotic cordon of our organic being, or self. It is then *us*, that is, personal to us. Outside that cordon, all energy appears to each one of us to be insentient. Sentience and insentience are merely other terms for subjectivity and objectivity, personality, and impersonality.

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Every last ion and corpuscle of matter is *alive*, in the sense that it may take its place and contribute its life to culminate with others in the life of a tree, or an animal. Each minute corpuscle is to itself a living, personal particle.

There are, therefore, no insentient forces; the universe moves because it lives, not lives because it moves insentiently. This latter doctrine had its day in a cumbrous philosophy and has passed to its bourne.

It is already apparent that the "atom," so called, is a highly organized life. All these "atoms" and "molecules" of our old-time chemistry are living creatures, often comparatively long-lived, even to a degree of immortality, yet still mortal and dissoluble under certain stress and duress of environment.

The point of this newer, better conception of nature is, that every corpuscle, ion, "atom," or "molecule" is in a lowly sense, a living thing, having what is to itself a sentient, personal life, and moving in space under the impulse of that life.

A busy New York lawyer who still finds time to consider *res ultima*, writes in a friendly spirit, to criticize what he deems a misuse of the terms *nature* and *natural*. His conception is still another instance of the hold which supernaturalism has even on the legal mind. "I do not

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regard science," he says, "meaning astronomy, geology, biology, etc., as being properly natural or in the order of nature. I regard science as distinct from and extrinsic to nature. Hence natural salvation, to be attained in the progress of science, is to me a confusion of terms, a misnomer."

In other words, the growth of human knowledge is not in the order of nature, but supernatural, or preternatural; not a part of the natural evolution of life on the earth, but something superadded to it, presumably from a supernatural source.

Another critic of more sectarian bias carries the same conception to greater length. "But for Christianity," he says, "which is a supernatural revelation from God to man, associated with a divine effort to save mankind, there would be no science. It is the elevation and enlightenment of the minds of men that come to us through Jesus Christ, which makes modern science possible."

This writer appears not to remember that science and the sciences were well advanced in India, Egypt, and Greece many centuries before the era of Jesus.

A teacher of biology writes: —

"You speak of the 'personal axis' of life, — the axis of self-consciousness in a cell, or in the human brain. What is meant by the term?"

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To answer this question fully, would require a careful presentation of the later discoveries touching the nature of "matter." It will, therefore, be better to reserve it for a paper which is to appear in the next edition of *Natural Salvation.*

Critics are of many types and tempers. Not a few condemn what their fellows approve.

"Who would want to live for centuries in a world like this!" writes "one who dissents." "Three score years and ten is quite enough of it. Too much. Think of the horrible monotony of a thousand years of human life. It is a frightful picture. The Lord deliver us from such as you! So far from encouraging an effort like yours, it should be summarily stopped, if not by an indignant public sentiment, then by government interference; that is, if there were the slightest danger of your bringing about such a calamity. I am happy to think there is not. Human life will never be much prolonged, for the very good reason that it ought not to be. It is not worth it; and nature will probably look out for that. So I do not fear you. Death is as much a part of the great scheme of things as Life. It is the other part of the great Plan. But lo and behold, a little dying mortal now thinks that he is going to change it all! It is enough to make the angels weep, and the devils laugh!"

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We will allow this to stand, and pass to another of similar purport, but bearing the impress of a less passionate mind.

"I should fear such a gift as you seek to confer on human beings. It does not seem to me that earthly life could be made of sufficient interest to give us continual enjoyment for long periods of time. The Wandering Jew was but a fiction, yet I believe it embodies the truth concerning human life on the earth. It does not seem to me that the earth offers, or can ever offer, a proper theater or arena for immortal life. I am therefore inclined to consider death as a blessing instead of an evil, and that your proposed effort to 'achieve' immortal life on the earth by applied science is a mistaken one."

The above is a thoughtful statement of a widely prevalent view of human life. It deserves an equally thoughtful reply.

It is conceded at the outset that life as the majority of our race now live, is not worth prolonging far beyond the pleasures of youth. Immortalizing such lives, subject to all their present ills, hardships, and discouragements, would be of the nature of a penalty, instead of a reward. If a greater experience which came from longer life did not enable them to attain a better mode of life, with fewer pains and ills, immortality on the earth would be inadvisable for them.

The earth is what we make it. The reason why the

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majority of mankind are miserable on the earth instead of happy, is to be found in them, in their ignorance and perverted minds, rather than that the earth does not afford an "arena" for happy life. Some are happy here, others not; the cause is largely subjective.

Considered physically, the terrestrial globe which we inhabit is not, under nature, a comfortable abode for man. But it has vast capabilities, enormous resources for improvement. It is capable of being made a paradise, a true Eden in the universe. Unlimited power falls on its surface from the solar sphere, power which can be bent to human uses. Its climate can be controlled and made whatever we desire it, its temperature regulated to the needs of life. It is not the earth in its present condition which we contemplate as the future abode of immortal man, but the earth improved and made "heaven." The paradisation of the earth presents merely physical problems, many of which are already being undertaken successfully. The earth, made heaven, is one of the conditions which will come with the achievement of immortal life. The dawn of this grand future for the sons of men is already breaking on the horizon of science; and what we have now most need of is faith and courage to work for it; to cast aside our slavish fears of the supernatural, and work to save ourselves from the ills of life; to cease from idle prayers to be saved by supernatural agencies, and devote our energies to self-salvation.

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Again, life on earth is not desirable for those on whom old age has set its insignia of infirmity and deformity with all the attendant daily pains and aches. A natural revulsion from life ensues from the senescent condition of the organism. Life grows less and less desirable, until often the aged one longs for release from it.

This mental attitude touching life is purely the result of the decline of the associate cell life of which the human body is composed. It is to the regeneration of the component cell life of the organism that our present researches are directed. The object of them is to renovate the tissues, renew the cells, and maintain the human body in the adolescent condition: the muscles and digestive organs in a state of normal health and efficiency, the brain in a condition of mental power, hopefulness, and ambition.

It is not likely that such a person would desire to die, at least, not on an improved and beautified earth where the growth of knowledge and the rapid advances of scientific discovery gave opportunity for continuous mental growth.

But, reverting to our passionate critic, it may be said that Natural Salvation would by no means sentence a man to life. It merely enlarges his freedom to live or not. He does not have to live. In the phrase of firm old Marcus Aurelius, "the open door" is always there, under his hand, with liberty to issue forth to the unknown gods.

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One who terms herself "a believer in Natural Salvation" has written to ask, "How can these truths be disseminated? How can this better faith be propagated?"

Desirable as such propagation would be, it is the author's opinion that this will not be best accomplished by direct efforts at proseliting, or propaganda. The capacity to receive truth comes from mental growth and the acquisition of knowledge. These truths will be apprehended and accepted as mental evolution in America proceeds. It is the growth of knowledge and the development of brain, which will prepare the way to accept Natural Salvation. Unformed, undeveloped mind is the stronghold of the old creeds. Further education is the only remedy.

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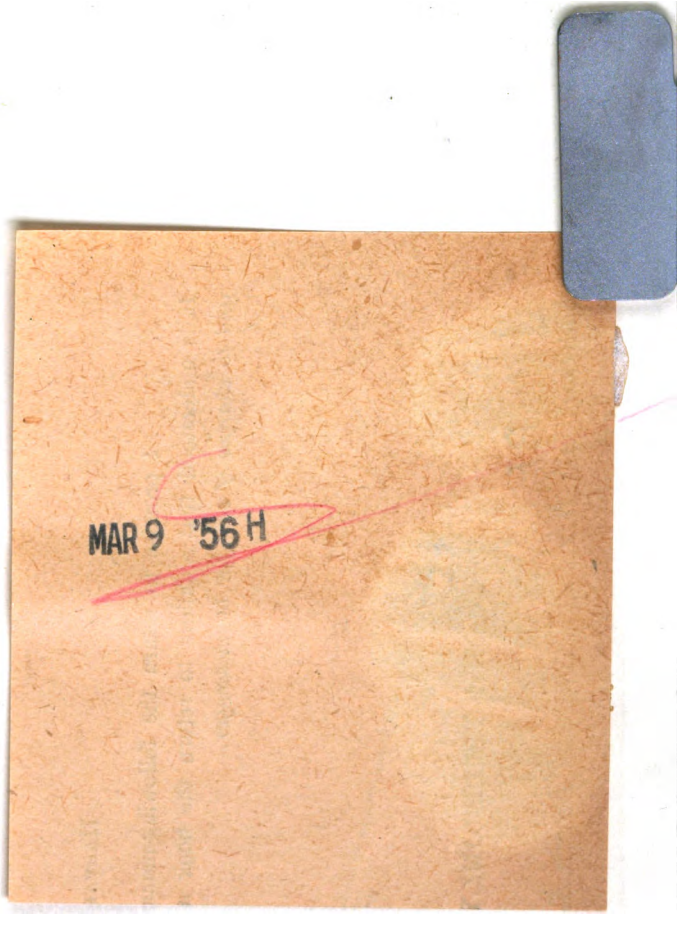

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